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September 20, 1928

Engineering News-Record

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Method of Building Coolidge Dam

Second of Two Articles on the Design and Construction of the First Great Multiple-Dome Dam

Upstream side of Coolidge Dam showing the three domes and two outlet control towers.

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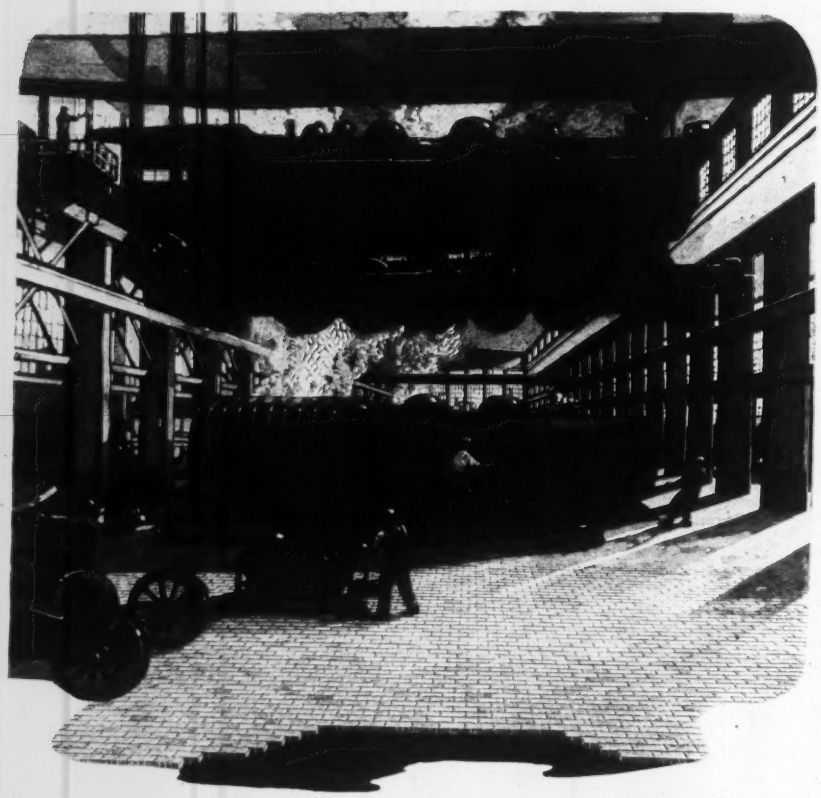

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Engineering News-Record

A Consolidation of Engineering News, Engineering Record, The Sanitary Engineer, and The Contractor

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Contents

Volume 101, Number 12, September 20, 1928

Steel Frame of Office Building 564 Ft. High 424

DETAILS OF CONSTRUCTION of the Greater Penobscot Building, recently completed, the tallest structure in Detroit.

Arthur Kill Bridges Paved With Vibrated Concrete 427

VIBRATING FORMS and use of trap rock aggregates produce roadway slab to withstand heavy traffic.

Traffic Increase of One-Third Ascribed to Toll Bridge 429

Precast Concrete Simplifies Imhoff Tank Work 430

DIFFICULTY of molding parts in place for complex tank structure at Flint, Mich., solved by precasting. By Walter L. Couse

Concrete Spur Dikes Maintain Deep River Channel 434

How TOPEKA'S water-supply intake is kept clear of sand bars by skeleton spur dikes of concrete. By Lloyd B. Smith

Should Engineers on Appraisal Work Tell the Truth? 436

DISCUSSION of what should be the code of ethics on such work and difficulties in way of truth telling. By Gregory M. Dexter

Construction Features, Coolidge Multiple-Dome Dam 438

How UNIQUE PROBLEMS in concrete forming were solved with notable success in this, the largest structure of its type.

Monthly Review of Engineering Literature 443

Divergent Views on Construction Safety Code 446

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Volume 101 NEW YORK, SEPTEMBER 20, 1928 Number 12

Self-Reliance in Irrigation

AT FREQUENT intervals during the past 30 years the farmers of a certain section of Nebraska have seen promising crops wither and die under the mid-summer sun for lack of water, although the Platte River was only a few miles away. Several promising schemes for irrigation were proposed and died from lack of funds or other difficulties. No one seemed inclined to build an irrigation system for these farmers, so they finally determined upon an unusual course of action—to finance the proposition themselves. The work took nearly five years and cost $350,000. Each man to benefit dug into his own pocket, added his money to the common fund and today the system is in operation. Such sturdy self-reliance is in refreshing contrast to the begging attitude of the farmers on many of the federal reclamation projects. Faith in the American farmer once more is restored.

Strength vs. Density

FOR a long time strength in compression was accepted as the criterion by which to judge of the suitability of concrete for dam construction. Then came the realization that maximum density did not always occur in concrete of maximum strength. In fact, porosity tests made on concrete of extremely high strength on a certain dam were so unsatisfactory that the mix had to be changed to one that gave less strength but considerably greater density. In dam construction density is the first desideratum; the strength requirements are much less exacting and of secondary character as compared with the imperative need for concrete that will neither pass nor absorb moisture. As soon as attention was focused on this situation, density was quite speedily and rather generally substituted for the strength criterion. However, this rapid adoption of a new standard was due to current interest in improved concrete mixes rather than to an interchange of ideas among those engaged in dam design. In this field, unfortunately, exchange of views goes on less readily and promptly than might be desired.

Kentucky Colonels

SEVERAL years ago *Engineering News-Record* undertook to compile a list of all the kinds of pseudo-engineers in existence. We have continued to keep the record, but the list is not yet complete, and probably never will be complete. One day the list is increased by a furniture mover who displays the title "Transportation Engineer" on his front bumper. Shortly after comes an old acquaintance, the "Fumigating Engineer," whose specialty may be divined by those of sufficient experience. Embarrassing though it be, this ever wider counterfeiting of the title belonging to our profession is a distinct compliment to the engineer and his work. Some will remember how in former times, in the day of the glamour of military titles, a great crop of Kentucky colonels sprang up—a clear expression of the esteem in which the title of Colonel was held. Correspondingly the present-day popularity of the title engineer means that the profession has attained a place of unusually high regard in the public eye. That there are countervailing objections to this form of popular flattery is obvious, and the time may come when the provisions of the registration laws may be invoked against the practice. But for the present the gain seems to outweigh the loss.

The Whole Truth

THERE can be but one answer to the question "Should appraisal engineers tell the truth?" as raised by Gregory M. Dexter on p. 436 of this issue. Strange to say, it is sometimes argued that an engineer retained by a client to appraise property whose value is in dispute stands in the relation of advocate to his client and should make out the best case possible. The most charitable thing to say of this argument is that it is unmoral. But even were the argument granted, the obligation to make out the best appraisal possible would carry with it no obligation for the engineer to perjure himself in so doing. An engineer called in to make an appraisal exercises the functions of an expert, and in strict terms the appraisal which he produces should be the same regardless of which side of the controversy employs him. Many instances are on record in which engineers—in valuation cases or as expert witnesses in civil or criminal suits—have told only part of the truth, and thereby produced testimony which they well knew they could not have justified had the case been tried by a jury of engineers. In a few instances quick-witted lawyers have made these engineers ridiculous by exposing the absurdity of some of their claims, and the whole profession has suffered thereby. In other instances, however, they have "got away with it," because of the ignorance of judge, jury and lawyers. Let it be repeated, therefore, that the engineer who serves as expert, whether in valuation or in other cause, has no more compelling duty than to tell not merely the truth, but the whole truth, to the best of his knowledge. If he violates this principle, he betrays his profession as he debases himself.

Let Us Think

THAT the engineer's principle is to think first and act afterward was remarked by John W. Alvord, consulting engineer, in a recent address on the Mississippi flood-control situation. This remark suggests the thought that compliance with the principle of necessity requires that the thinking shall be broad and clear, covering the whole ground, before any decision is arrived at or any plan of action is materialized. But is this principle followed as closely and as frequently as it should be? In other words, with a problem presented to him, does the

engineer—whether consultant or assistant—always proceed to visualize, study, analyze and review it thoroughly as a whole, without bias or prejudice, before attacking its solution? Does it not happen rather often that some particular or conspicuous feature or factor is allowed to obtrude itself or attract attention at the outset, and that the subsequent thinking is then—more or less unconsciously—influenced by and adapted to this phase of the problem? The aim, then, is to adapt the solution to this particular factor rather than to consider all factors at first on an equal basis. Possibly the diverse opinions of experts on any given problem may indicate something of this mental attitude. There are times and emergencies, of course, when action must follow thought immediately. Certain prominent conditions may then of necessity be taken as a basis for action, although more extended study might develop other and better methods. In the above remarks, however, reference is made only to cases in which there is no question of haste or immediate decision. It may be well for the engineer to stop occasionally and consider how he is doing his thinking, and if he is giving sufficient thought as a preliminary to action or decision. Let us think, and let us be sure that our thinking is adequate to the occasion.

Sidewalks for Roads

SIDEWALKS are to have particular consideration in the new road construction of Allegheny County, Pennsylvania. Official approval by the county commissioners has been given to a proposal to build these separate paths for pedestrians along new highways, at least in the populous districts. With its recent large bond issue for roadbuilding the county has in this order of approval made an advance upon which it is to be congratulated. As, too, it was one condition in the indorsement of the bond issue by the Pittsburgh Chamber of Commerce that the plans for the new highways should include sidewalks "at least on one side of each thoroughfare," the county road officials can count on the support of the best public sentiment in their sidewalk planning. In this fact they are again fortunate. The situation leads to comparison. The county of Allegheny has the authority and the power to provide sidewalks on its county roads, but the state of Pennsylvania has no power and authority so to improve its state roads. The provision of sidewalks on public highways is solely the function of local government in Pennsylvania. It is so in the states generally. There must in general be legislative enactment if the sidewalk construction urged constantly by public safety agencies and sporadically by the newspapers is to be an integral element of our state systems of highways. Lawmaking requires popular sentiment. The greatest obstacle today to the creation of sidewalk safeguards is public disbelief in their necessity. With thousands of miles of the main roadway not adequately surfaced on the highway system of nearly every state, it is a difficult task to justify before the people any considerable outlay for pedestrian sidepaths. Where the need is actually pressing, their provision is regarded as a task entirely of concern to the locality in which the need exists. It is important in our thinking and discussion of sidepaths for public roads that these facts be kept in mind. Often they are not considered, and road officials are being unjustly criticised for lack of concern for the safety of those who walk the highways. The truth is that they lack power to spend money for sidewalks, and that there is no general demand by the public for them.

A Construction Achievement

SHEER ingenuity in form design reduced the usual complexity of multi-curved concrete slab construction to comparative simplicity on the domes of the Coolidge dam, whose construction is described in this issue. The domes were built with flexible-panel sectional forms moved up as succeeding lifts were concreted and for a large part of the curved structure had no support outside the structure itself, being hung from "wishbone" steel bars doweled into the preceding pour. Thus was the intricate overhanging curved slab built with no more elaborate formwork than is ordinarily used on vertical walls.

In the design of this flexible form paneling, capable of being warped to the double curve of a dome, and devising means of its self-support, true creative work in form construction for domes and other warped surfaces stands to the credit of those who built the Coolidge dam. It made possible the use of one set of form panels to fit constantly changing curves, simplifying a difficult construction operation that is usually the terror of the form builder.

However, the builders of the Coolidge dam did not limit their good work to form design and construction. Given but two and a half years to complete a project not only large in size but new in principle and design, situated in an inaccessible spot 8 miles from rail connections, the contractor must of necessity gather an organization and plan his work to carry on at top speed. Further caution was required by the dam's location on a typical flashy Western stream capable of reaching a flood of 100,000 sec.-ft. Despite the complex nature of the work, adverse weather conditions and an overrun of 10 per cent on quantities, the project is being completed nine months ahead of schedule. Such performance is a credit to the contractor's entire organization and all concerned. It is a speaking demonstration of capable planning and management of difficult construction work.

Storm Fury

ONCE again the power of great winds has made itself felt in widespread destruction. Porto Rico is devastated, and from the fragmentary accounts that have reached the outside world the island and some of its neighbors have gone through one of the great storm disasters of human history. Florida also did not wholly escape damage from the same storm in its later movements. However, almost simultaneous with the cyclonic hurricane in the West Indies, tornadoes struck widely separated regions in the United States. The tragic effects of these visitations tell anew of mankind's slowness in making headway against the strength of the elements.

One of the early reports from the Porto Rican storm area included the statement that the official anemometer was blown away long before the wind reached its greatest height. This is a repetition—one is tempted to say an expected repetition—of what has happened time and time again. The scientists of the weather have consistently failed to meet the obligations of their task. Yet without the data that science should furnish we can only make empirical and groping headway against the storm foe. Chiefly because of the regularly repeated failures of scientific observations, we still lack accurate knowledge of the forces exerted by great storm winds, and must rely

on uncertain inferences from the behavior of engineering structures.

Practical instincts have also been an obstacle to progress in making the world proof against storm. Great storms are infrequent, and men are willing to take chances; they are unwilling to plan and build against the severest storm stress when there is a chance that they may escape for years and perhaps forever. In the Caribbean regions, the focus of great hurricanes, all ordinary structures are built lightly, for the weather conditions of normal times only. Cities in Florida, which are visited by West Indian hurricanes every few years, still officially prescribe for building designs a wind pressure of twenty pounds or so, adequate in less turbulent regions, but far from equaling the force of a tropical hurricane.

In respect to tornadoes, progress is still more seriously hampered. Knowledge of the forces which tornadoes may exert is virtually zero, whereas hurricane forces are subject to at least some rough estimate. Tornado tracks are narrow, and the exposure of any one house or even town is therefore small. Moreover, the willingness to take chances is accompanied by an almost fatalistic belief that the power of a tornado is able to overcome the strength of anything that man can build, and that it is useless to attempt any protection beyond a refuge for human beings. Hence the country dweller in the flat plains of the central Mississippi Valley has his "cyclone cellar" and leaves his property the prey of the elements. After all, this is natural. But it is startling to find that city building practice also takes no account of tornado possibilities—a practice weakly supported by the fact that so far no central city district has been in the path of a really violent tornado.

Whether the disaster at Rockford will tell a new story cannot yet be judged from the few facts at hand. An old wooden factory building contributed the principal loss of life, a type of building usually bare of all vestige of engineering design and planned by crude rule-of-thumb methods. The destruction of such a building is little likely to throw new light on wind forces or resistance of structures, but merely carries the sharp warning that the medieval practice of building without the protection of engineering design should be abolished. The world has advanced too far to permit its citizens to continue defenseless against storm fury.

Progress in Concreting Imhoff Tanks

FEW structures offer greater obstacles to convenience in molding concrete in place than the modern two-story Imhoff tank. The roof-shaped partitions or baffle-walls which separate the upper and lower tank compartments offer an almost insuperable hindrance to free pouring and form handling. These partitions are thin slabs heavily reinforced; their lower edges hang free and overlap the sidewalls, and their slope is such that with ordinary poured concrete consistencies an upper as well as an under form is necessary.

Obviously the form structure called for is not simple, but the real construction difficulty is removing the under forms after the slab is molded. For this operation there is only the narrow gas-vent opening at the ridge of the partition. This requires the forms to be torn virtually to pieces. Naturally contractors have sought means to escape this destructive task and the handicap that it places on rapid construction. The latest outcome of their efforts is remarkably exemplified in the Imhoff tank construction at Flint. Here precast baffle-wall slabs (first used in building the West Side sewage-works in Chicago) were employed virtually to the utmost limit.

Several successive steps have been taken toward the simplification of Imhoff tank form construction and concrete placing in the last decade, through (1) increased form movability, when using poured concrete; (2) elimination of concrete pouring, and coincidentally of the upper form, by substituting gunite for concrete; and (3) elimination of formwork by constructing the baffle-walls of precast slabs. None of the latter processes has done away with those that preceded it. Pouring in place and guniting are still general; guniting has not displaced pouring; neither it nor pouring has been displaced by precasting—indeed recent practice supports pouring in place and guniting more than it does precasting. But precasting has established itself as an important alternative process of baffle-wall construction.

Precasting is the final step of constructors in their struggle to overcome the difficulty of form handling. This movement began in poured-in-place construction with the devising of sectional forms having elements small enough to be handled through the gas-vent slots and capable of being knocked down and set up quickly inside the lower tank compartment. The measures developed, while notably ingenious, did not do away with the ever-present uncertainty of securing a dense, homogeneous slab of concrete poured between narrow forms and into a close network of reinforcing bars.

The development of cement-gun work suggested a way to overcome in part at least these objections to the poured-in-place concreting process. The guniting process did away with the upper form and made certain a dense slab with well-embedded reinforcement. The under form still remained a problem, though a little less difficult one, since the nature of the process reduced loads and rendered extreme tightness at form joints less necessary.

The idea of precast slab construction had its genesis in several considerations. Precasting eliminated the under form. It insured a sound slab of high strength because the casting process made every detail of the pouring visible and wide open for the workmen to get the concrete dense and well settled around the reinforcement. The handling and placing of the cast slab gave it a severe proof test. Finally, increased speed of construction became possible; the slabs could be cast independently of the wall concreting and then could be placed swiftly without any waiting on form construction or for the slab to harden and get strength enough to be self-supporting. The Imhoff-tank construction at Flint illustrates particularly well each of these construction advantages.

It is notable that each of the steps narrated has been taken primarily to improve construction methods. The improvement of structure so far as improvement is realized was a subordinate consideration; the primary aim was to cheapen and hasten construction. It was this motive that led to the invention of sectional under forms, the adoption of guniting and the use of precasting. Economic comparisons are still subject to dispute, especially as exact comparative data are wanting.

These developments show clearly that the contractor and the construction engineer today are devoting as close and intelligent thought to their particular problems as ever the designer has devoted to the economics of structure. This attitude of analysis portends progress in the coming period of great costs and great speed required in engineering construction.

Steel Frame of Office Building 564 Ft. High

Girders Over Banking Room Carry Interior Columns—Tall Columns Braced at Top and Bottom—Wind Bracing—Height 666½ Ft. to Top of Beacon Tower

THE tallest building in Detroit, 666½ ft. from sidewalk to top of steel, is the 47-story Greater Penobscot Building, recently completed, a general view of which is shown in Fig. 2. From the first floor to the parapet of main building the height is 564 ft., above which a steel beacon-light tower for airway signals extends 122½ ft. Typical framing elevations are shown in Fig. 1. In plan, the structure is slightly unsymmetrical, having a frontage of about 138 ft. on Griswold St. and 144½ ft. on Fort St., with rear widths of 138 ft. and 152 ft. respectively. The steel frame was completed March 29, 1928.

Beginning at the sixth floor the typical office floor is in the form of an H, with light courts on the two 138-ft. sides, as shown in Fig. 3. Below the sixth floor is a large and lofty banking room without interior columns and spanned by girders and trusses required to support columns of the upper stories. Story heights vary from 12 to 17 ft. in the lower stories, except that the main banking room space, 40x100 ft., is about 44 ft. high. In the upper or office floors the height averages 11 ft., but from the 30th to the 31st floor the height is 15½ ft. on account of a pipe space. Offsets or setbacks are made in the upper parts, as is usual in buildings of such great height. In the Fort St. front the full elevation or size extends to the 31st floor, where the first setback occurs. At the Griswold St. front, the two arms of the H extend to the 38th floor. A description of the foundations for this building was given in *Engineering News-Record* of Dec. 29, 1927, p. 1034.

Column Sections—Several unusual column sections were required to meet special conditions, and some of these sections are shown in Fig. 6. At the corners, to avoid interference with stone, columns of shapes shown at *A* and *B* were used. It will be noticed that in section *B* the two webs are not at right angles to each other, but are parallel to the walls. In the Fort St. side of the building, large windows prevent wind-bracing connections to certain columns for several stories. A section shown at *C* was used for two of these columns. At the sides of the banking room are a number of large columns which support loads of more than 5,000,000 lb. At their tops each of these large columns supports the end of a pair of girders, which in turn support three columns, as shown in Figs. 3 and 4. Each of these girders has a center web, and, in addition, two reinforcing web plates at each end. These reinforcing web plates are outside of the flange angles, so that the rivets connecting the flange angles to the webs are in quadruple shear. The girders are far enough apart so that stub columns are connected to their webs and extend up a short distance above the tops of the girders to receive the columns from above, which are connected to the stubs by ordinary column splices.

The columns which support the large girders are designed so that the web of each girder is placed against and above a column flange. The upper flanges of these girders are at the sixth floor, and the lower flanges are

FIG. 2—GREATER PENOBSCOT BUILDING, DETROIT
Height, 666½ ft. to top of beacon tower.

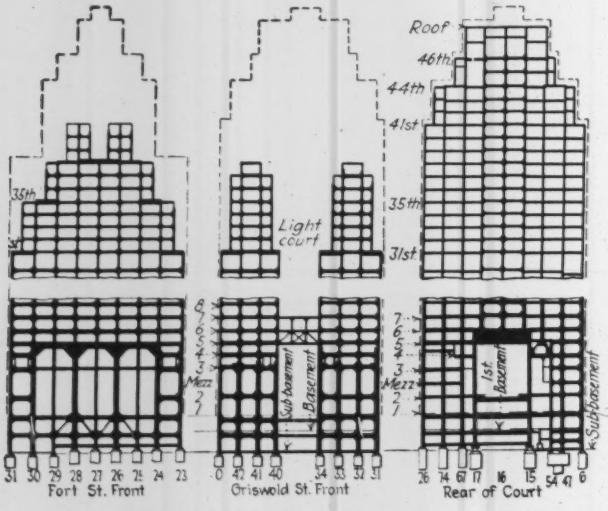
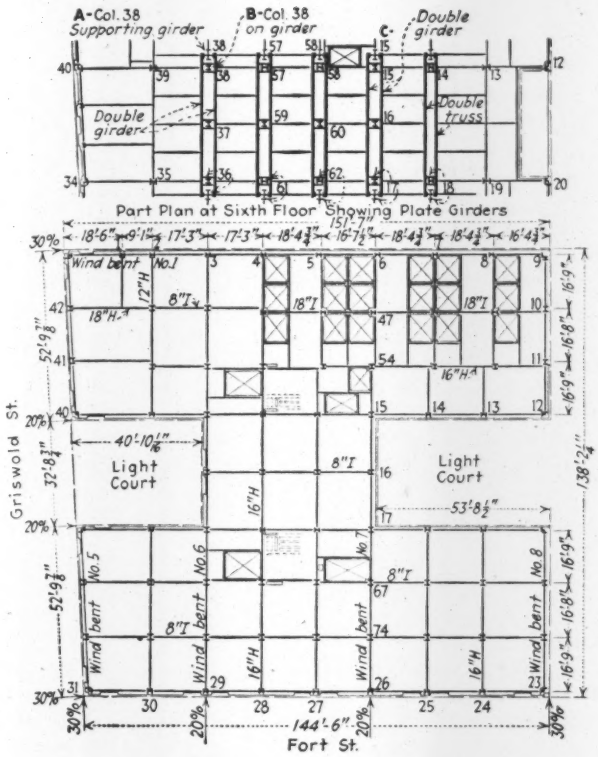


FIG. 1—TYPICAL ELEVATIONS, SHOWING WIND BRACING

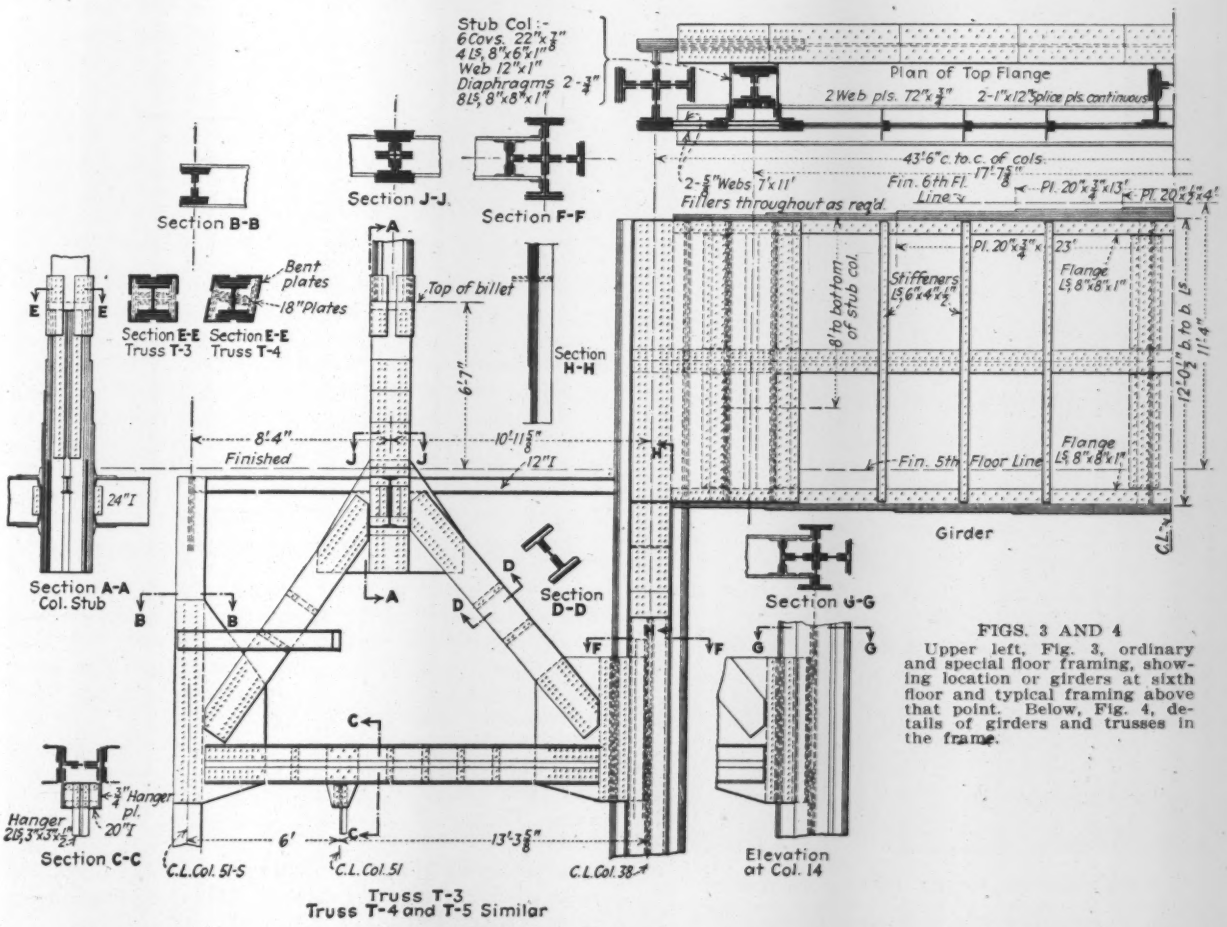


below the level of the fifth floor construction. Details of some short heavy trusses are shown at the left in Fig. 4.

Wind Bracing—The design of the wind bracing presented many interesting problems, and a number of unusual details were developed. In order to show this bracing for the entire height of the building on one drawing, small elevations at a scale of $\frac{1}{32}$ in. to the foot were used, similar to those reproduced in part in Fig. 1. The lower part of the building, being more complicated, was shown to a scale of $\frac{1}{8}$ in. to the foot. A portion of this more detailed drawing is shown in Fig. 6.

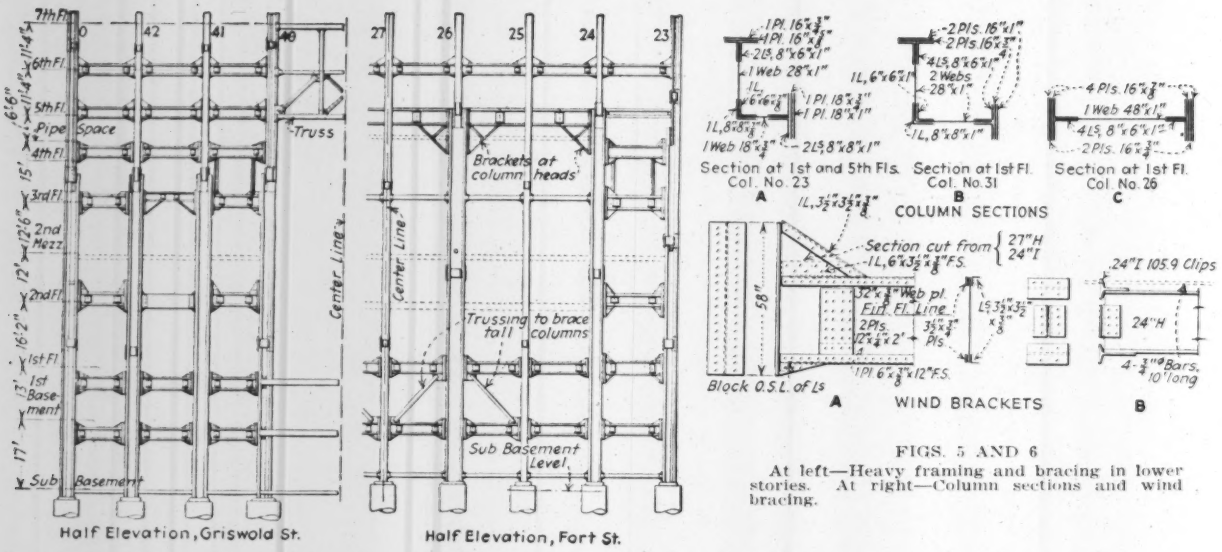
A 20-lb. wind was assumed for the entire height of the building, and above the sixth floor the wind load was assumed divided along four lines each way, as indicated by the per cent marks in Fig. 3. Below the sixth floor more lines were used and the distribution was more complicated. Allowable stresses were increased 33⅓ per cent for the cases where wind governed. When a strong moment-resisting connection is provided at the ends of a beam or girder, there is a tendency for it to act as a continuous beam under gravity loads. In general, the wind-bracing connections in this building were designed for moments obtained by combining the wind moments with the negative moments produced by the gravity loads, assuming the beams to act as continuous beams.

Three very large windows are arranged in the Fort St. elevation. Between and at the sides at these windows special columns were used, as noted above. In order to assist in stiffening these columns against bending from



FIGS. 3 AND 4

Upper left, Fig. 3, ordinary and special floor framing, showing location or girders at sixth floor and typical framing above that point. Below, Fig. 4, details of girders and trusses in the frame.



FIGS. 5 AND 6

At left—Heavy framing and bracing in lower stories. At right—Column sections and wind bracing.

the wind load, brackets about 11 ft. deep were used at the fifth floor and diagonals were used below the first floor, as shown in Fig. 1. These brackets and diagonals are shown also in Fig. 6.

Typical wind-bracing connections are shown in Fig. 6. In connection for spandrel beams, *A*, it will be seen that a piece of I-beam is used for the connection to the column in place of a gusset and two angles. The web of the I-beam takes the place of the gusset, and one flange takes the place of the two angles. With this detail the rivets ordinarily used for connecting the angles to the gusset are saved. At *B* is a typical wind-bracing connection for interior beams, having $1\frac{1}{4}$-in. rivets and I-beam clips top and bottom. As the gravity load moment always produces tension at the top and compression at the bottom, the maximum combined stress which can be produced at the top of the connection is tension and the maximum stress which can be produced at the bottom is compression. It is because of this condition that the bottom I-beam clip has a stronger connection to the beam than to the column. Reinforcing bars have been added at the top on each side of the column in order to help out the four $1\frac{1}{4}$-in. rivets in tension.

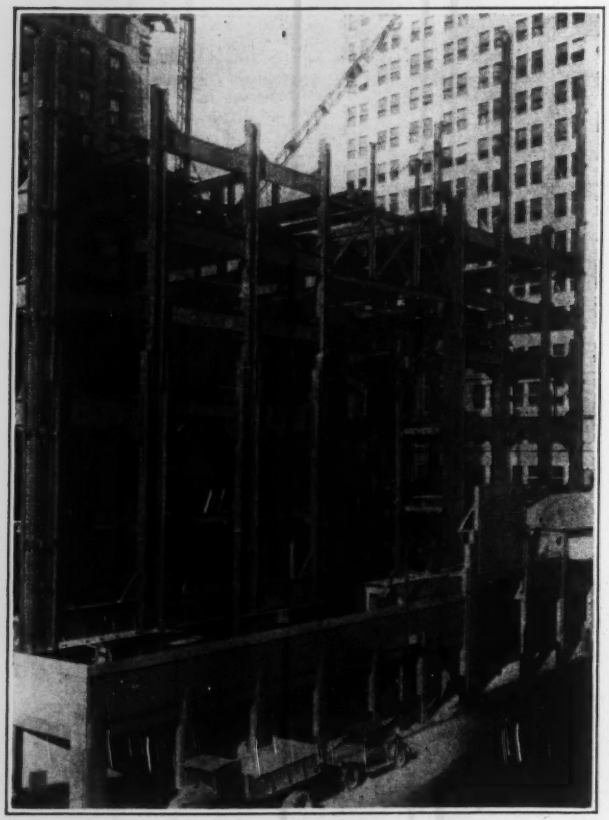


FIG. 7—STEEL WORK DURING ERECTION

Note heavy construction of built-up columns and plate-girder spandrel beams in Griswold St. front.

Because of architectural requirements, it was necessary to make some of the wind-bracing girders of shallower depth than would otherwise have been used. In order to make up for this small depth, such girders were made extra heavy—that is, low stresses were used in their design. A 24-in. girder with a stress of 9,000 lb. per sq.in. will deflect no more than a 48-in. girder with a stress of 18,000 lb. per sq.in.

The Greater Penobscot Building is being built for the Simon J. Murphy Company. Smith, Hinchman & Grylls are the architects and engineers, with Donaldson & Meier as advisory architects. The A. A. Albrecht Company has the general contract. The structural steel was fabricated by the American Bridge Company and was erected by the Detroit Steel Construction Company.

Ohio River Development Nears Completion

A slack-water depth for navigation of 9 ft. along the Ohio River from Pittsburgh, Pa., to Cairo, Ill., will be assured with the completion of five government dams now under construction. Of these, Dam No. 46 at Owensboro, Ky., will be ready in a short time. Two others, Dam No. 59, near Weston, Ky., and Dam No. 52, below Brookport, Ill., will be completed before Dec. 30. The remaining two, Dam No. 51, at Golconda, Ill., and Dam No. 53, near Joppa, Ill., will be finished next year. The completion of three dams during the fiscal year ended July 1, 1927, brings the total of government dams now in service in the Ohio River to 45. A total of 785 miles of river has been canalized, 700 miles being consecutive between Pittsburgh, Pa., and Addison, Ky.

Arthur Kill Bridges Paved With Joggled and Vibrated Concrete

Vibrated Forms and Use of Trap Rock Aggregates and Special Finish Produce Roadway Slab to Withstand Heavy Traffic

TO SECURE a pavement of dense and strong concrete for the two highway bridges across the Arthur Kill between the mainland of New Jersey and Staten Island, New York, the engineers required the concrete to be compacted by vibrating the forms. The desire was to secure a concrete that would test 2,500 lb. in 28 days—a fairly dry mixture—and that would have a particularly hard surface to resist the wear of exceptionally heavy traffic. Two alternative mixtures and paving processes were considered as capable of giving the desired results and as two different constructions enabled a study of comparative service both were specified and used. The two constructions were:

1. All-trap-rock coarse aggregate with care used in finishing to keep the rock near the surface and at the same time get a smooth slab.

2. Ordinary stone or gravel aggregate with a layer of 1 to 2½ in. trap rock forced into the slab top; the layer was to be of such thickness that 1 cu.yd. of stone would cover no more than 50 sq.yd.

Concrete with a slump of 3 in. was desired, although a slump of 4 in. was permitted. To insure density and uniformity with so dry a mix, all slab forms were required to be vibrated with pneumatic hammers immediately in advance and adjacent to the place where concrete was being poured. The amount and location of each type of construction were designated by the engineer.

Incidentally, these specifications were called into question as violating the New Jersey law which prohibits in public-works construction the payment of any royalties on patented or proprietary materials or processes and requires open competition between such materials and processes and non-patented materials and processes. A public hearing of the case by the Port of New York Authority, at which representatives of the Governor of New Jersey were present, resulted in dismissal of the charges of law violation and the work went ahead as specified. The construction as developed are the subject of this article.

Bridge and Pavement Structure—The two Arthur Kill bridges are similar structures consisting each of a cantilever main span and plate-girder approach spans all on concrete piers. A general description of the bridges was published in *Engineering News-Record*, Aug. 26, 1926, p. 346, and a full description of the pier construction—there were some 160 piers—was published in

FIG. 2—CONCRETE CAR USED ON OUTERBRIDGE CROSSING DECK PAVING

Engineering News-Record, Nov. 10, 1927, p. 744. In the succeeding issue of Nov. 17, 1927, p. 815, the charges and hearings on the legality of the specifications were outlined.

Altogether the total length of bridge structures paved was 16,027 ft., or a little more than 3 miles. Of this footage about 3,252 ft. was on main spans and the remainder on viaduct approach. A section of the main span paving slab for the Outerbridge Crossing is shown in Fig. 1. All other slabs were substantially similar, and as the paving operations on the two bridges were similar, only those on the Outerbridge Crossing from Perth Amboy, N. J., to Tottenville, Staten Island, N. Y., will be described. This paving divides into two kinds, all-trap-rock concrete slab and trap-rock-finish concrete slab, both being used to compare the wearing qualities of the two types. Each is considered by itself.

All-Trap-Rock Concrete—All of the truss spans of the Outerbridge Crossing were paved with the all-trap-rock concrete. The slab rests on longitudinal I-beams spaced on 5 ft. 4 in. centers as shown in Fig. 1. Both wood and steel forms were used. The wood forms were made up in panels with 2x6-in. joists spaced 3 ft. The ends of the joists rested in wire hangers thrown over the I-beams and holding similar joists on the other side of the beam.

The steel forms were made in sections 3½ ft. wide and long enough to span between beams. Four eccentric lugs, one at each corner, clamped on the upper flange

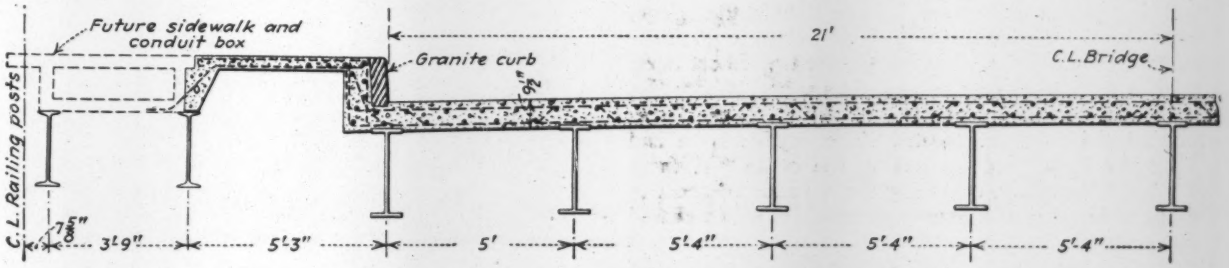


FIG. 1—TYPICAL CROSS-SECTION OR PAVING SLAB ON MAIN SPANS, ARTHUR KILL BRIDGES

FIG. 3—VIBRATING DECK FORMS WITH PNEUMATIC HAMMER

of the I-beams, held in place by pins through a slotted arm on each lug. The forms were easily dropped by pulling the pins, thus releasing the lugs. The design of the lugs is patented.

A traveling suspended working platform allowing about 5 ft. of headroom enabled the workmen to place both wood and steel forms with safety. The platform was hung from rollers engaging two continuous I-beam rails clamped to the bridge beams low enough to clear the cross-girders. An electric motor propelled the platform, obtaining its power from a gasoline-driven generator set of the farm-lighting type.

The concrete for the entire bridge paving was mixed in a central plant built on the New Jersey shore of Arthur Kill just south of the bridge. This allowed barge delivery of all materials. The proportioning of fine and coarse aggregate was determined by weight, considering a sack of cement as 1 cu.ft. in volume and weighing 94 lb. From the mixer the concrete was hauled 500 ft. in narrow-gage cars by gas dinkies to a tower, and there hoisted 125 ft. in a roller hoist bucket to a receiving hopper above the bridge deck level. High hopper cars with attached chutes as shown in Fig. 2 carried the mix to the point of deposition, hauled by gas locomotives. As only half the roadway width was poured at a time, there was always plenty of room for the track. Daily pours ran as high as 500 lin.ft. of the 21-ft. width.

As far as possible the concrete was spouted to place without rehandling. Portable chutes resting on wooden horses supplemented the car chutes when the concrete was being placed on the side of the slab farthest from the track. The contractor on this section used jackhammers (Fig. 3) for vibrating the forms. Short blunt steel bits were used on the steel forms, and rubber tips were added for use on wood forms. Vibrating the forms produced the expected results. The dry concrete had a tendency to pile up on leaving the chute. Without much hand shoveling, operating the hammer adjacent to the pile reduced it to a homogeneous mass which flowed easily under the bottom reinforcing, with the mortar well distributed throughout. The mortar following close to the hammer bit can be seen in Fig. 3 and also in Fig. 4.

The slab was finished by striking off with a steel templet followed by longitudinal floating. Hand leveling and tamping preceded the templet where necessary. After longitudinal floating the slab was floated transversely until all surface water had disappeared. Final finishing was done with a bow belt and a broom. The maximum deviation allowed from a true surface by the specifications was $\frac{1}{16}$ in. per foot from points of contact, using a 10-ft. straight-edge.

The slab was cured with wet burlap and salt hay for the first 36 hours; the burlap was then removed and the surface was kept wet for ten days by water from a perforated pipe laid along the high side.

Mastic expansion joints were placed at every transverse girder, with special sliding steel plate joints at points designed for expansion in the bridge steel.

Trap-Rock-Finish Slabs—One of the land approaches and the concrete beam and girder section at the east end were paved with concrete mixed with ordinary aggregates and finished with a trap-rock surface. Although the specifications did not designate any special method of forcing the trap rock into the surface, the contractors vibrated the finish rock into place with a motor-driven vibrator on narrow slat mats. The trap rock was spread by hand after the slab had been poured to the required thickness. The appearance of the slab after vibrating the finish into place is shown in Fig. 5.

This method of placing the trap-rock finish produced a slab of great density. Walking on the concrete immediately after vibrating showed no effects except disturbing the thin mortar surface. The concrete or mortar did not come up over the soles of a man's shoes when walking on the fresh concrete. The slab was finished by the same methods as were the all-trap-rock slabs.

The contractor on the concrete beam and girder section used pneumatic clay diggers with long handles and blunt steel bits for vibrating the forms during the slab pouring (Fig. 4). These tools secured the same results as the jackhammers previously described.

All slabs on earthfill were poured with paving mixers. In pouring the beam and girder slab section the contractor used buggies charged from an overhead hop-

FIG. 4—TYPE OF HAMMER USED IN VIBRATING SLAB AND GIRDER FORMS

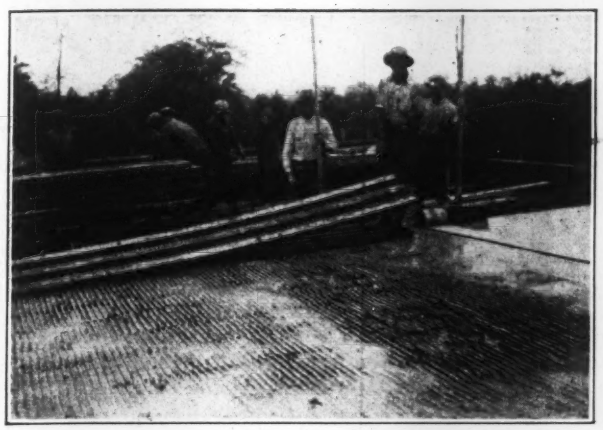


FIG. 5—SLAB AFTER FORCING TRAP-ROCK FINISH INTO PLACE WITH MOTOR-DRIVEN VIBRATOR

per. A crawler crane was used to fill this hopper from the mixer, which was on a lower level at the side of the approach. An unloading plant at the east side of the Kill enabled the contractor on the east end to use barge deliveries for materials which were reloaded into batch trucks and hauled to the mixer. At the extreme west end of the bridge batched materials were delivered by truck through Perth Amboy.

The structures were designed by Waddell & Hardesty, consulting engineers, New York, under the direction of O. H. Ammann, chief engineer of bridges, and W. J. Boucher, engineer of construction, of the Port of New York Authority. R. T. Robinson was resident engineer on the Goethals bridge, and A. H. Morrill was resident engineer on the Outerbridge Crossing. The paving contractors on the Goethals bridge were: bridge span, Albert A. Volk, Inc., New York; east and west plazas, the Elizabeth Paving Company, Elizabeth, N. J. On the Outerbridge Crossing the paving contractors were: main span and approaches, Cornell Contracting Company, New York; east abutment and fill, W. H. Gahagan, Inc., Brooklyn; west plaza, Triest Contracting Corporation, New York.

Deep Water Canal Proposed Across Isthmus of Chignecto

Construction of a deep water canal across the Isthmus of Chignecto connecting the Gulf of St. Lawrence with the Bay of Fundy is being advocated by the Amherst Board of Trade. H. J. Logan, a former member of the Canadian House of Commons, is associated with the board in the development of the project and heads a committee which is working on it. J. Simon Armstrong, of Fredericton, N. B., a veteran engineer, who was familiar with the survey of the old Baie Verte canal project, has been called into conference. Board of Trade officials are gathering particulars of shipping that would utilize the canal, which it is proposed to dig through the isthmus connecting Nova Scotia to New Brunswick. The distance across the isthmus from Baie Verte on the Gulf of St. Lawrence side to Cumberland Basin, an arm of the Bay of Fundy, is 16 miles. The canal would bring Charlottetown, Prince Edward Island, 365 miles closer by water to St. John and would greatly shorten the distance between Montreal and New York or Boston.

Traffic Increase of One-Third Ascribed to Toll Bridge

AN INCREASE of 33.5 per cent in vehicular traffic across Carquinez Strait near San Francisco, Calif., is attributed to the construction of the toll bridge recently completed at that point. This percentage of increase, estimated by the American Toll Bridge Company, owner and operator of the bridge, is based on the data given in the following. Traffic on the Rodeo-Vallejo ferry, which the bridge replaces, for six years preceding the construction of the bridge is listed in the accompanying table:

Year	Total Vehicles Carried	Increase (Per Cent)	Decrease (Per Cent)
1921	399,768	....	
1922*	334,601	....	16
1923	412,689	23.4	..
1924	465,063	11.5	..
1925†	504,276	8.4	..
1926	599,155	18.4	..
1927‡	659,000	10	..

*The Rodeo-Vallejo ferry purchased the competing Six Minute Ferry Company and abandoned its service.
†Rates reduced 30 per cent by the State Railroad Commission.
‡Estimated traffic over Rodeo-Vallejo ferry if Carquinez bridge had not been constructed.

In the first year of operation of the bridge (May 21, 1927, to May 21, 1928) 1,115,830 vehicles crossed the bridge, as compared with 605,391 vehicles that crossed on the Rodeo ferry in the preceding twelve months (May 21, 1926, to May 21, 1927). The difference in these two figures is 510,439 vehicles.

However, there are other means of crossing this strait still in operation—namely, the Martinez-Benicia ferry and the Monticello Steamship Company, so that traffic on those lines must also be considered to make a true comparison. Data for this are given in the following tables:

Total Traffic Across Carquinez Strait	1926	1927 (Estimated) Without Bridge
Rodeo Vallejo ferry	599,155	659,000
Martinez Benicia ferry	171,422	188,400
Monticello Steamship Company	113,200	124,000
Estimated total, without bridge	971,400	

Traffic Across Strait May 21, 1927, to May 12, 1928	
Carquinez bridge	1,115,840
Martinez Benicia ferry	139,604
Monticello Steamship Company	41,000
Total	1,296,444
Estimated without bridge	971,400
Increase	325,044

On this basis of comparison—that is, taking an estimated total for 1927 on three boat lines without the bridge, as compared with the actual total of bridge and two boat lines for the first twelve months' operation of the bridge—there is shown an increase of 325,044 vehicles, or a 33½ per cent increase over the estimated total for that twelve-month period if the bridge had not been built.

Power Output of Reclamation Projects

The U. S. Bureau of Reclamation had in operation on its various projects during 1927 a total of 23 power plants, with an installed capacity of 99,698 kw. The first cost of these plants was $6,069,525, operating and maintenance expenses were $276,016, and the estimated depreciation was $276,092. Exclusive of depreciation, the cost of producing power was 0.557c. per kilowatt-hour. Of the power produced, 57,124,621 kw.-hr. was used for irrigation and other uses, while 139,663,636 kw.-hr. was sold to private individuals, companies and associations.

Precast Concrete Simplifies Imhoff Tank Work

Complex Tank Structure Characterizes Flint, Mich., Sewage-Works—Difficulty of Molding Parts in Place Solved by Precasting—Twin Derricks Place 1,100 Precast Panels

By Walter L. Couse

Formerly Resident Engineer, City Engineering Department, Flint, Mich.

NOTABLE concrete construction procedure was employed in building the Imhoff tanks of the new sewage-works for Flint, Mich. These tanks were of new design and of unusually complex structure. By precasting some 1,100 of the tank parts difficult to mold in place, by multiple use of forms and by a working plan and a plant setup which reduces rehandling, a normally tedious concreting task was converted into a reasonably fast and straightforward operation. The place of the Imhoff tanks in the Flint sewage-works was described, and the reasons for their unique design were explained, in *Engineering News-Record* Sept. 6, 1928, p. 357. How they were constructed is told here.

Tank Structure—The Imhoff unit, as shown by Fig. 1, consisted of four tanks, each divided into eighteen hexagonal cells. A section through two cells from outer wall to tank center is shown by Fig. 2. The views and the drawings emphasize the constructor's problem imposed by the design. It was to build a honeycomb of thin reinforced-concrete walls, floors and cell covers. The concrete volumes were moderate. The spread of concrete placement was reasonably compact. The honeycomb complexity of structure is spectacularly indicated by Fig. 3.

The main operations were: (1) footing and bottom construction, (2) wall construction and (3) cover construction—that is, sludge panels, gas vents and walks. Footings, walls and tank bottoms were straightforward tank-building operations of molding concrete in place. Complexity and difficult construction in place came in the cover concreting. Not only was fussy formwork required but the removal of inside forms was a task of reducing the forms virtually to their component boards and joists. It would almost be necessary to build a full set of forms for the 72 cell tops and their connecting walkways. The thin sections made pouring difficult and uncertain. In brief, the whole operation of concreting sludge panels, gas vents and walkways in place appeared impracticable. It was decided to meet the difficulty by building the cover parts of precast concrete panels, with grouted joints.

Location and Access—The site covered 135 acres on the south bank of the Flint River about 5 miles by highway from Flint. Two roads reached the site from Flint, one paved and the other a good gravel road. The nearest railroad being in Flint, it was necessary to truck from there all material and equipment. Labor was entirely local and was brought to the job daily by trucks. Washed sand and pebbles required a haul of 14 miles by truck. Six 3½-yd. trucks maintained a regular schedule of five trips a day as long as the gravel roads stayed open. In the spring breakup the roads were closed for three weeks to all but light cars. The number of trucks was increased to ten and twelve for short periods as occasion demanded.

Excavation for Tanks—A 1¾-yd. dragline made the original cut, casting the material, and then two smaller draglines retrieved the cast material and swung it clear of the site. Work was begun in the fall and was carried on throughout the winter, dynamiting being necessary to break the 30-in. crust of frost. It was completed on March 12, 1927, with a total execution of 34,000 cu.yd. There were only three days lost time. The large dragline worked from the bank, making an average cut of 16 ft. The two small draglines stood in tandem, to the rear and to the right or left, as the case required, recasting the dirt taken from the hole.

Little hand work was necessary. The greater amount was in the excavation for the cell bottoms, which were inverted hexagonal pyramids. Such hand grading for footings as was necessary followed closely behind the draglines. In all hand grading air spades were necessary. The soil was hard, dry blue clay, with clay and gravel above. The bottom was ideal for footings, and it was possible to leave the pit walls almost sheer without fear of a cave-in.

Plant Layout—The main plant units were: (1) a material storage and form construction yard, (2) twin derricks covering the tank area and (3) mixing plants. The structures of the first unit were arranged on two sides of the road entering the site from the north. They comprised sawmill, lumber yard, blacksmith shop, tool house and job offices on the east side of the road, and a storage yard for pipe and structural steel on the west side. In conjunction with the blacksmith shop and tool house there was a 15,000-gal. tank for water storage. Adjoining the lumber storage yard and sawmill was the form-construction yard, where the forms for all walls, slabs and precast work were made.

The outstanding unit in the plant set-up was twin derricks, each carrying a 135-ft. boom capable of spanning two tanks and of reaching the central mixing plant.

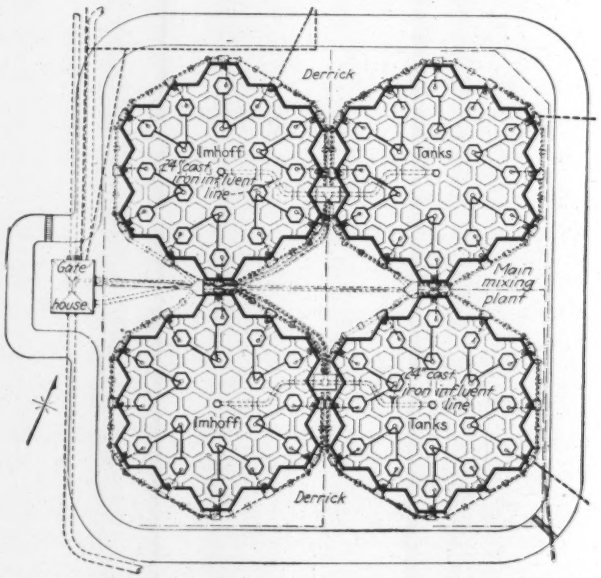


FIG. 1—DIAGRAM OF IMHOFF TANK OF EIGHTEEN CELLS

These derricks (Fig. 4) were located one north and one south of the tanks on the north-south center line between them (Fig. 1). The base of each was blocked up 16 ft. to allow for free use of the boom when the top section of the outside walls was in place. The operator's shanty, however, was placed on the ground. The derricks handled all concrete by means of ¾-yd. buckets. They placed all formwork which had previously been made as units. They carried to advantageous points all steel, and placed in position ready for calking all cast-iron piping, which varied in size from 4 in. to 42 in. During hand excavation for the cell bottoms the derricks removed all the dirt. Most important of all, they placed in position more than 1,100 precast panels of all sizes, the heaviest of which weighed 3 tons.

During the full period of construction the contractor made use of three distinct mixing plants. The largest and main plant was located on the east side of the tanks and in the central crotch between the north and south tanks, so the derricks could both reach it conveniently. A smaller plant was located near the southeast corner of the excavation for emergency use during the earlier stages of construction and it received considerable use on days when heavy pours were made. The third plant was located adjacent to the form construction yard. This plant was used to pour all precast sidewalks and fence posts and was used only during last half of job.

Laying Out the Work—On account of the unusual shape of the tank structure, more than usual care was necessary in laying out the work. The center line between the tanks and bisecting the gatehouse was established as a base line, and therefrom the center of each tank was located. In each tank a base line for that tank was established, running north and south through the center. The centers of all cells in each tank were then established from the tank center and base line, the six immediately around the center being at 24-ft. radius from the center and from each adjacent cell. Each cell of the outside group was likewise on a 24-ft. radius from each neighboring cell. So it was possible to have not less than five checks on each point. All cell centers were checked daily, as long as these points were necessary.

As an aid in preserving the accuracy of these points and in adjusting them if necessary, a batter board was

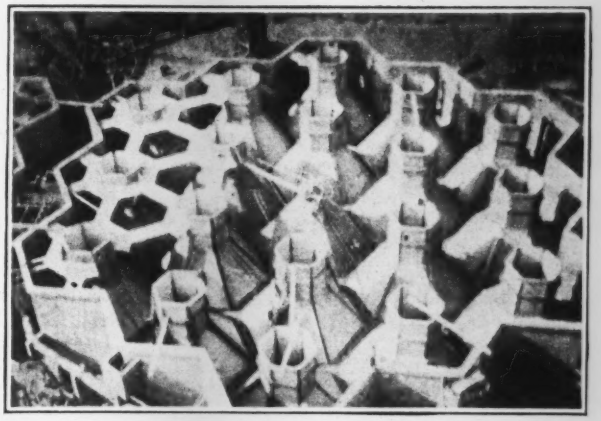


FIG. 3—TANK AND CELLS NEARING COMPLETION

erected in the center of each cell and substantially braced. The batter board tops were set at an elevation above the footings, and by chalk line and plumb-bob the center lines and intersections of all footings were accurately arrived at by the form crews. Without care at this stage of the construction, the placing of the 1,100 precast panels might easily have been hopeless.

Concrete Mixes—The concrete was divided into four classes: A 1:1½:2 mix, with a 3-in. slump, was used for all precast and special work requiring high strength; a 1:2:3.35 mix and a 5-in. slump were used for all footings, walls and general work; a 1:3:6 mix was used for all pipe supports and piers, and a 1:12 (bank run) mix was used for pipe backfill and underfootings. To make the mix more plastic and to prevent segregation, diatomaceous silica, 3 lb. to each sack of cement, was added to the concrete.

Concreting in Winter—The concreting of the footings followed excavation as rapidly as possible and so was carried on throughout the winter. The footings were covered with tarpaulins and straw, under which were placed salamanders. The sand and gravel piles were thoroughly steamed and the water used was passed over steampipes. Frequent temperature tests were made. The average temperature of the concrete leaving the mixer was 85 deg., followed by a drop to an average of 78 deg. after two hours in the forms. When uncovered ten days after pouring, the concrete would still be warm to the touch, with an average temperature of 65 deg. There were only three delayed pours resulting from cold weather. The coldest weather was 14 deg. below zero with an average of 15 deg. to 20 deg. above.

Wall Forms and Concreting—Wall concreting followed the footings as closely as possible. The forms were fabricated in the form-construction yard and made ready to be picked up and set in place as units. In each tank there were 30 identical sections to the outside wall.

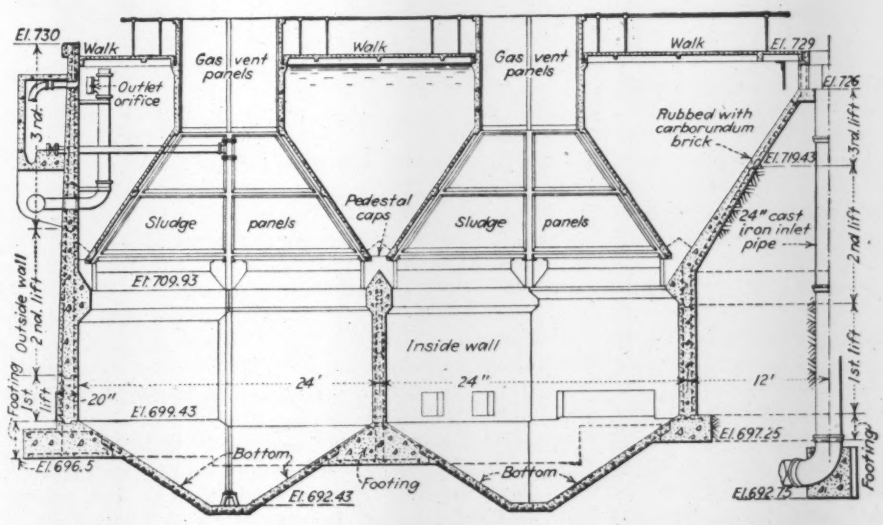


FIG. 2—SECTION THROUGH TWO CELLS OF IMHOFF TANK

One set of ten sections for two tanks was fabricated which was reset six times. Three sets of forms for each rise in the outside wall, one of which was 3½ ft. and the two others 14 ft. high, were sufficient for the four tanks. There were 30 sections to the inside (cell) walls in each tank, excluding those walls immediately surrounding the intake pipe. Here it was possible to fabricate one set of fifteen sections for two tanks, which allowed the use of that set four times. Two sets of these forms were sufficient for the four tanks. Two sets of six forms each were fabricated for each rise in the walls immediately surrounding the 24-in. intake pipe in the four tanks. This group of walls was poured in three

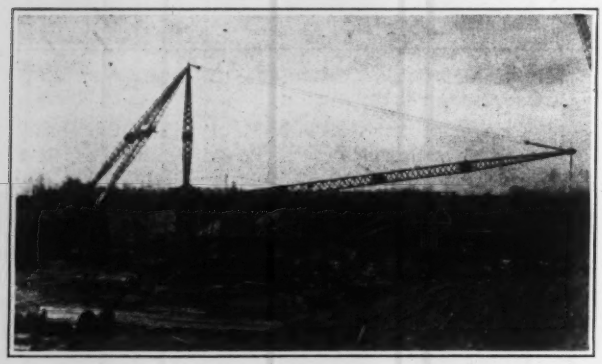


FIG. 4—ONE OF TWIN DERRICKS COVERING FOUR TANKS

rises, one for the vertical section and two for the inclined section.

After fabrication the forms, as required, were lifted into place by the derrick, ¾-in. pipe spreaders were inserted at regular intervals and a common type of form clamp was applied. When a set of forms was in position for the pour, the derrick then handled the concrete; 21 cu.ft. of concrete was handled on each trip. The average round trip from mixer to form and return was from 2 to 2½ minutes, which insured at least a 2-minute mix. To insure a perfect bond between two pours the joint of the old section was scrubbed clean and, when starting the new pour, a thin grout of cement and sand mixed 1:1 was poured on to a depth of about 2 in.

Precast Concrete—One of the most important operations was constructing and placing 1,300 pieces of precast concrete, ranging in size from small fence posts to large sludge panels weighing 3½ tons each. Due to the similarity of the groups of panels, such as sludge panels, gas vent panels and sidewalks, it was possible to fabricate a set of forms for each group and use that set again and again. There were two sets of eighteen forms fabricated for the sludge panels and likewise two sets fabricated for the gas vent panels. Each set was used twelve times, making a total of 432 of each of these panels poured.

At the time of pouring these panels all the walls in two tanks were completed, hence it was possible to lay one of each of the forms for sludge and vent panels in each cell on a platform constructed for the purpose, make the pour and after final settings remove the panel and leave it upright against the wall of the cell to season. In this way each panel was poured and then stored within reach of the two derricks, which reduced handling expenses as well as pouring expenses.

The sidewalk panels, being the last to be placed, were of necessity poured off to one side and then hauled within reach of the derricks. There were three types of walks: the short sections reaching from the outside walls to the outside ring of gas vents; the long sections connecting the eighteen gas vents in each tank, about 15 ft.; and another group of long sections leading from the top of the walls surrounding the inlet at the center of each tank to the inside ring of gas vents. Of the first group, 120 pieces were alike, 144 in the second group and 24 in the last group. It was planned to complete these in twelve pours, so ten forms were fabricated for the first group, twelve for the second and only two for the third. Here again the number of forms, very expensive to make because of intricate construction and exacting requirements as to measurements, was reduced to a minimum. These slabs were poured during the summer and care was taken during curing to guard against cracking. After pouring and obtaining first set, burlap bags were spread over each slab and then drenched with water daily for a period of two weeks.

Placement of Precast Work—It was planned to erect complete the vents of two cells each day. Wood support towers were assembled, which the derricks lifted in place as a unit. One of these support towers was placed in the center of a cell and there braced ready to act as a temporary guide and support for the group of panels making up that vent cone (Fig. 5).

Extreme care was exercised in placing the sludge and gas panels in order to preserve exact measurement and

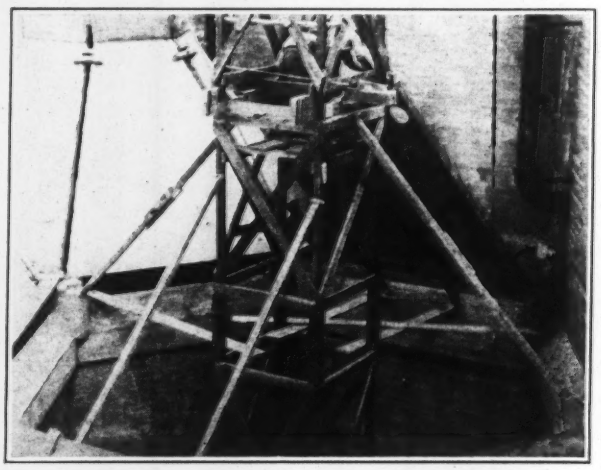


FIG. 5—WOOD TOWER FOR PLACING SLUDGE PANELS

avoid any future possibility of trouble in placing the sidewalk slabs. It was necessary that the first cell set be one of the outside group, so that all errors might be carried toward the center, where a slight readjustment was possible. The first panel set was measured accurately to each corner from the face of the outside wall to insure its being parallel to that wall and at the proper distance. The second panel set was directly opposite the first with the tops 8 ft. apart. The third was again one on the wall side, with the fourth directly opposite. Wood wedges were employed to adjust these panels. After the six sludge panels had been placed a templet of the exact size and shape of the finished top of the cell was placed on top of the panels on which the positions of the six gas vent panels was indicated. The six panels forming the complete unit were then adjusted to exact location and shape as nearly as possible. After all panels were in position, clamps and wedges were

inserted in the joints to keep the panels from collapsing after the removal of the support tower. These wedges and clamps were only temporary and were removed after the joints were gunited. It required the erection of four or five vents before the above procedure was perfected, but after the crew became accustomed to the process little trouble was experienced.

The closing of the joints between panels (Fig. 6) by guniting followed after a short period and proceeded rapidly. Guniting proved an ideal method, although care had to be taken to keep the waste from reaching the bottoms of the cells. Planks, which also served as walkways, were placed over the gaps separating adjacent sludge panels and were very effective in catching this waste. The cement gun work was done by the Cement Gun Company of Chicago, Ill.

After the guniting of the joints came the placing of the sidewalk slabs. Due to precautions already taken

FIG. 6—PANELS READY FOR GUNITING JOINTS

little trouble was encountered. Practically no adjustment was necessary at the center of the tanks, as the walks surrounding the center fitted precisely.

Derrick Operated by Telephone—An interesting feature in the placing of all precast work, the erection of forms and placing of concrete and the placing of all pipe work after the outside walls were in position was the manner of communication with the derrick engineers. This work was handled by the assembly and form crews, whose only contact with the derrick operators was by means of a telephone system and a central operator, who was located at a point overlooking all tanks. The derrick operators were 15 ft. below the tops of the walls and could see nothing that was being done inside the tank area. Each wore a head receiver through which he received instructions from the central operator, who received his signal instructions from the various crews. This proved to be a fast and a safe procedure, as there were no confusing signals and the derrick engineers were able to work with more confidence and speed.

Quantities—It is interesting to note that, compared with the engineer's estimate of 8,765 cu.yd. of concrete entering into the completed structure, which required 15,531 bbl. of cement, there was actually poured 8,800 cu.yd. and a total of 15,892 bbl. of cement was used. This showed an excess of approximately 330 bbl. of cement, half of which was used by the contractor in erecting his equipment, giving a net excess for the completed job of less than 1 per cent over that estimated. Another point of interest was that, while the specifications for bulk concrete called for 2,200-lb. tests, an average of over 2,500 lb. was maintained, with frequent samples going higher. The specifications for all precast work called for 3,000-lb. concrete, but here again a higher average was maintained, two samples reaching as high as 3,300 lb. in ten days.

Completion—Sewage was admitted to the first two of the tanks, after a week of bypassing, on Oct. 10, 1927, and to the last two on Oct. 13, practically a year from the date of starting construction.

The plant was designed by Hoad, Decker, Shoecraft & Drury, consulting engineers, Ann Arbor, Mich. It was constructed under the supervision of Harry C. McClure, city engineer, with the designers acting as consultants and Walter L. Couse as resident engineer. The general contractor was the W. E. Wood Company, of Detroit and Flint, Mich.

Prevention of Termite Damage

The bureau of entomology, Department of Agriculture, is carrying on an extensive series of tests which will lead to the better control of termites and the prevention of their destructive activity in American woods. The bureau has a testing plant on Barro Colorado Island, Canal Zone, where woods are chemically treated and driven into the ground to study the effects of various preservatives. There is also a cottage constructed of redwood, which is believed to have a repellent action on the white ant. At this station a model demonstration termite-proof building was erected in co-operation with the American Wood Preservers Association during August, 1926. This building was constructed entirely of wood, all of which had been impregnated before framing with such standard preservatives as coal-tar creosote and zinc chloride. The treatments were made by both the full- and empty-cell pressure processes of impregnation. The treatment selected in each case was that most suitable for the position of the timber or lumber in the structure. Thirty species of wood-destroying termite occur on Barro Colorado Island.

The bureau is also experimenting with various types of mortar which will prevent termite from getting up into buildings. Various test walls to determine the most effective combination for foundations below the surface of the ground have been erected at Falls Church, Va., Washington, D. C., and Urbana, Ill. A campaign to have rules incorporated into city building codes requiring constructors to take proper precautions against the termite is being waged. It is stated that the destruction wrought by these insects often amounts to from $2,000 to $3,000 per individual building, because the constructors are either ignorant of white ants or fail to take proper precautions against them.

Concrete Spur Dikes Maintain Deep River Channel

Topeka's Water-Supply Intake in Kansas River Kept Clear of Sand Bars by Skeleton Spur Dikes of Concrete Placed Near Mid-Stream

By Lloyd B. Smith

Chief Engineer, Smith Concrete Jetty Company, Topeka, Kan.

THREATENED with a water famine during low-water stages of the Kansas River, the city of Topeka, Kan., has resorted to the use of skeleton retards or jetties to provide a deep channel at the water-supply intake. In 1921 the city replaced the failing well supply with a river supply system, building an intake 100 ft. out into the river.

Average low water in the Kansas River is 3 ft. deep, but this is by no means a uniform depth, every rise leaving sand bars and deep pockets at random. Unless artificially cared for, the intake level would often be left dry by the shifting riverbed. At the time of constructing the intake pier a line of steel skeleton retards was installed from a point 2,000 ft. upstream and 400 ft. from the bank to a point 60 ft. out from the pier end. Shortly after the completion of the intake system a heavy flood swept away about 250 ft. of the lower end of the retard. The riverbed rose gradually around the intake until in the unusually low water of 1925 the water supply was seriously endangered.

To repair the dike and re-establish a deep channel, reinforced-concrete retards similar in design to that shown in Fig. 2 were used, spaced 12 ft. 6 in. centers. The arms, however, were 2-in. galvanized pipe filled with concrete instead of the reinforced-concrete arms later used, with a reinforced-concrete center block holding them in place. The units in this installation stood but 4 ft. high, as they were needed only in low water, and at this height offered little resistance to flood flow. They were tied together at the bottom by 42-in. wire mesh and two $\frac{3}{8}$-in. cables, and at the top by three $\frac{3}{8}$-in. cables. Mesh with 2x4-in. openings was found to be the most effective size to deflect the current and form sand bars. Fig. 3 shows this repaired section soon after installation and after a rise in the river.

The floods in the winter and spring of 1927 so impaired the usefulness of the original steel retards that a sand bar formed in the race, deflecting the current to the opposite bank and again threatening the water supply. Beginning some 1,200 ft. above the intake pier, a line of dikes of reinforced-concrete skeleton consruction was extended downstream to meet the 1925 installation. These units were as detailed in Fig. 2. Four reinforced-concrete arms 5 in. in diameter were cast individually, then held in place by a reinforced-concrete center block. The arms formed the diagonals of a rectangular prism with a base 5x5 ft. and a height of 7 ft.

The reinforcing for each arm consisted of six $\frac{1}{2}$-in. round bars inside a $4\frac{1}{2}$-in. No. 6 wire spiral, 6 in. pitch, which had been shaped around a wooden cylinder.

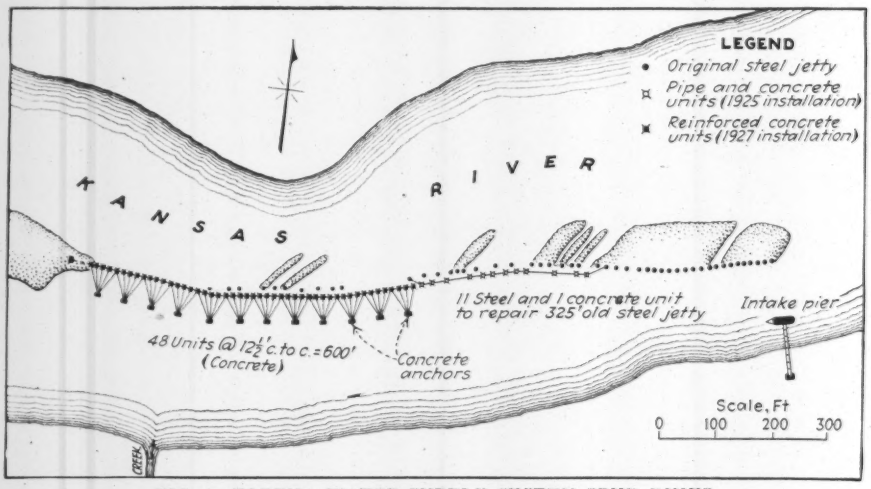

LEGEND
Original steel jetty
Pipe and concrete units (1925 installation)
Reinforced concrete units (1927 installation)
KANSAS RIVER
11 Steel and 1 concrete unit to repair 325' old steel jetty
Intake pier
48 Units @ 12½' c. to c. = 600' (Concrete)
Concrete anchors
Scale, Ft
0 100 200 300

FIG. 1—TOPEKA WATER-SUPPLY SYSTEM SPUR DIKES

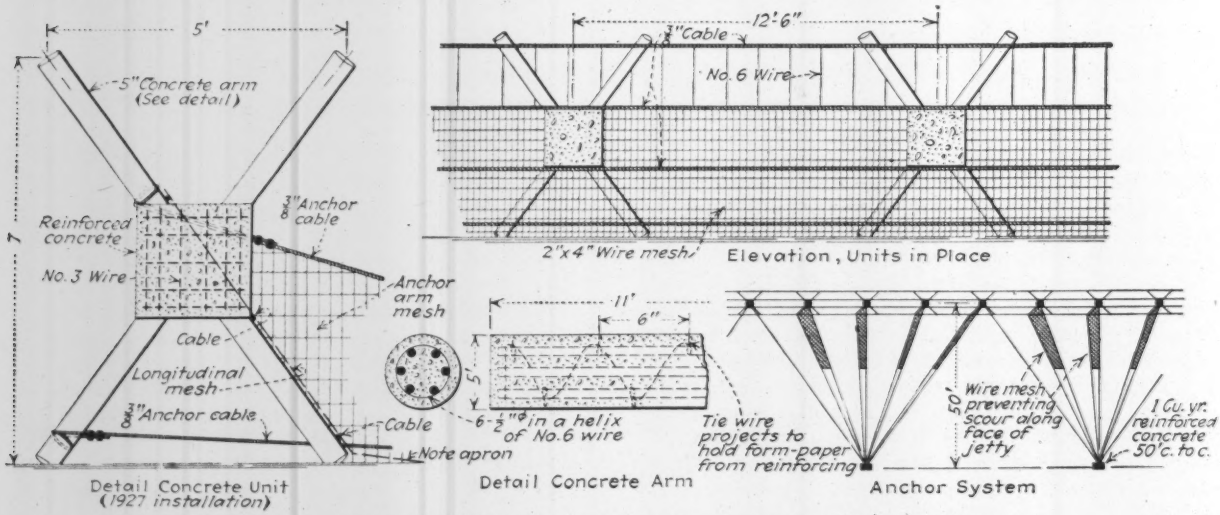


FIG. 2—DETAILS OF THE SKELETON RETARDS USED TO FORM SPUR DIKES

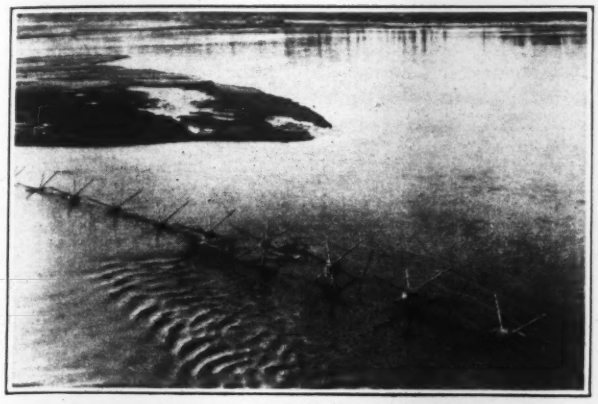


FIG. 3—SKELETON UNITS IN PLACE

Above—Pipe arm units (1925 installation) at time of installation. Note bar forming to right of the retard. Below—Same after a 4 ft. river rise. Deep raceway maintained at left side of dike.

Ruberoid roofing wrapped around the assembled spiral provided the concrete form. Projecting loops of ¼ in. at each reinforcing tie centered the form about the spiral. The cylinders thus formed were placed on end and filled with a 1:2 mortar. After setting they were assembled as shown in Fig. 4, tied temporarily by wire. A wooden bottom form was suspended from the arms for the center block. Ruberoid was again used for the center block

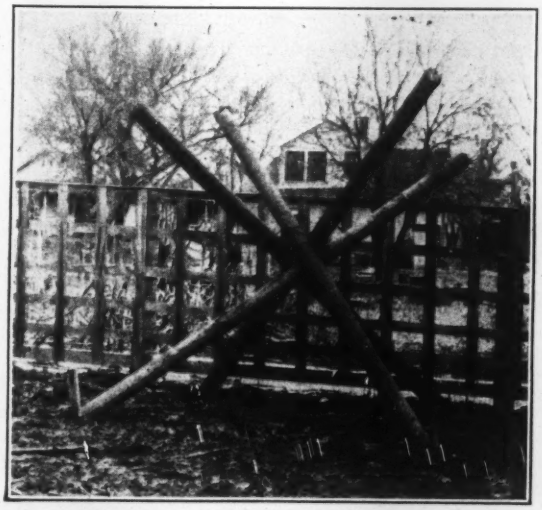


FIG. 4—REINFORCED-CONCRETE ARMS ASSEMBLED TO RECEIVE CENTER BLOCK

side forms, wrapped with wire to provide the necessary stiffness. The blocks were reinforced with No. 3 wire.

All fabrication was done on the shore. As most of these units were set in about 4 ft. of water, a derrick barge was used for placing. A 52-in. wire mesh and four ⅜-in. cables hold the skeletons to each other. To provide further stability, each unit is fastened by two ⅜-in. cables to a concrete anchor in the race. To these anchor cables is attached 25 ft. of wire mesh with proper apron extensions to protect the units from undermining.

This retard installation has maintained a minimum depth of 7 ft. at the intake pier, thus assuring a constant water supply for the city. The retards were built under patents and applications owned and controlled by the Smith Concrete Jetty Company, Topeka, Kan.

Preservative Coating Test Results

Results of tests on preservative coatings for steel surfaces being conducted by the American Society for Testing Materials, as of November, 1927, were reported at the annual meeting of the society in June. The following table gives the details:

RESULTS OF TESTS TO DETERMINE THE EFFECT OF VARIOUS METHODS OF PREPARATION OF STEEL SURFACES ON THE PRESERVATION OF SUCH SURFACES BY PAINT

Panel	Surface Condition and Preparation	Spreading Rate, Sq.Ft. Per Gal.	Duration of Good Preservation	
			Altoona	Brooklyn
		Average Per Coat	Elapsed Years.	Elapsed Years
	New Steel Panels			
No. 1	Clean surface, mill scale intact, no surface cleaning or treatment, painted in warm, dry room	916	5	4
No. 2	Mill scale broken, some rust and grease, hand cleaned with benzine, scraper and wire brush, painted in warm, dry room	826	6	2
No. 3	Sandblasted, painted immediately after in warm, dry room	785	9	2
No. 4	Sandblasted, heated in oven to 225 deg. F., then painted	899	7	2
No. 5	Sandblasted, placed in cool damp room 40 minutes, then painted	706	9	2
No. 6	Sandblasted, placed out doors and painted there at a temperature of 25 to 30 deg. F.	542	10¼	5
No. 7	Sandblasted, exposed out of doors for seven days, painted over rust in warm, dry room	914	8+	3
No. 8	Pickled, neutralized, washed with hot water, painted in warm, dry room	807	10¼	2
No. 9	Pickled, neutralized, washed with hot water, exposed out of doors seven days, painted over rust in warm, dry room	1028	7	2
No. 10	Exposed to weather 6 mos., cleaned with wire brush and scraper	653	1	1
No. 10a	Former Brooklyn panel No. 10, reprepared by sandblasting one-half surface, hand cleaning the other half of same, painted June 13, 1921	†	6½ 3	....
No. 11	Pickled, washed with cold water under pressure, painted in warm, dry room	801	10¼	1
No. 16	Incompletely sandblasted, painted in warm, dry room	818	6	4
	Old Steel Panels			
No. 12	Cleaned with wire brush only	629	9	2
No. 13	Cleaned with benzine, scraper and wire brush	726	7	2
No. 14	Benzine applied over rust spots and burned off with torch, then cleaned with scraper and wire brush	730	8	5
No. 15	Sandblasted	767	7	2

*Rated 95 per cent on Nov. 10, 1927. †Not recorded.

In the Brooklyn test the duration of good preservative was shorter than might have been anticipated, the report states, and the panels which were not sandblasted or pickled were preserved as long generally as those which were so treated. The differences in atmosphere and in exposure to mechanical injury from windblown particles were considered to be factors in the results.

Should Engineers on Appraisal Work Tell the Truth?

Are They, in Making Appraisals, to Adopt the Attitude Assumed by Lawyers Toward Their Clients?

By Gregory M. Dexter

Executive Engineer, Eastern Division, Honolulu Iron Works, New York, N. Y.

ENGINEERS frequently insist that great differences in appraisals are simply the result of honest expression of opinion. In a measure that is true. This discussion is concerned not so much with honest differences as it is with those that arise when the fundamentals have been agreed upon and still engineers cannot come anywhere near an agreement. A great many of these differences are nothing more than examples of what happens when an engineer is incompetent or subordinates what is just to what he is told to do by some politician or executive. Such deplorable conditions are doing much to discredit the valuations reported by all engineers. They forcibly suggest the question as to whether appraisal engineers should tell the truth.

Some years ago two groups of engineers appraised a public utility. Their valuations differed by many millions of dollars. Before a committee of arbitration they agreed upon a valuation that was essentially an average. Such engineering wastes money. It does not require skill. It is not appraisal work but rather an example of two horse traders lying about the merits of their respective horses and knowing very well that neither believes the other. In another instance various engineering employees of, and engineering salesmen who had sold to, an industrial corporation made affidavits that certain high rates of depreciation were proper. Representatives of a governmental division insisted that equally low rates were proper. A consulting engineer recommended rates by no means so high as the highest and somewhat higher than the lowest. With one minor exception, these were accepted. Again, money had been wasted by misrepresentation.

In a difficult appraisal an engineer made every effort to tell the whole truth. Another engineer, who represented a governmental division, examined the work. No doubtful point was hidden from him. He was shown all assumptions made until he was convinced that a reasonably correct result had been obtained. He recommended the acceptance of the appraisal. Later, under instructions from his superior, he tore the appraisal to pieces on every possible pretext. Finally he was so frank as to say that it would probably have been accepted if all statements had been presented as facts. By so doing he placed a premium on misrepresentation. He reduced the engineer to the level of the lawyer who words all statements very carefully so as to tell the truth as far as they go but who remains silent on all doubtful points in the hope that they will not be discovered by his opponent.

Many engineers appear to believe that both their clients and justice will be better served by balancing partisan claims than by the impartial attitude of the scientist. Yet the best training and the most liberal education of the engineer are based on the methods of the scientist. They have made possible the great contributions of the engineer to the welfare of his fellows. Shall we disregard them on appraisals?

One engineer testified for a public utility that certain shacks had a valuation much higher than that which the man in the street would allow. Engineers understood the theory of appraisal that made such testimony possible. The newspapers did not understand it. They picked on it as having good news value. This engineer did not state his honest belief, since he frequently uses another theory of appraisal. He damaged the standing of engineers.

Another engineer testified for a public utility that certain operating conditions were satisfactory. The general public, the public service commission and the newspapers knew the contrary to be true. His testimony in the face of a general and justified dissatisfaction was ludicrous. It helps to explain the lack of appreciation by the general public of which many engineers complain.

Nobody short of the Omnipotent can determine the exact truth. The limited human mind of the engineer must resort to approximations and agreements in determining an acceptable truth. The recognition of the justice of much in the claims of other engineers is the sign of a broad technical knowledge and a liberal mind. Those qualities are lacking in some engineers. Hence two groups of engineers will report valuations of a property so far apart as to make the man in the street laugh at them for claiming special ability. Very possibly that is why business men and bankers buy and sell industrial properties and public utilities so frequently without obtaining a valuation from competent engineers.

Support for Criticisms—Support for these criticisms is found in such a conservative magazine as the *Nation's Business*, published by the Chamber of Commerce of the United States, in an article in the issue of November, 1927, by Merryle Stanley Rukeyser, entitled "Public Utilities Face Attack." He quotes one of the older leaders in the public utility field, in disapproval of the purchase of utilities by some business men, as follows:

"They sometimes err in paying absurdly high prices for operating properties.

"For five years we have been in a rising market, and fortunately for them and their followers their extravagant appraisals have been in time validated. . . .

"Engineers' estimates of property values have sometimes been inflated, sometimes purposely to offset the unduly low appraisals of city engineers who were bent on attaining rate reductions."

Sympathetic Understanding Necessary—Destructive criticism has been so far the substance of this discussion. It is an engineer's easiest task. It will be worthless unless it is tempered with a sympathetic understanding of the difficulties surrounding the work of an appraisal engineer.

While the engineer is trained to give some observance to a code of ethics, he frequently has to work with executives who do not recognize much of any code other than that of making large profits. On important appraisal disputes, he has to co-operate with lawyers whose code requires that they give their client the best possible defense by presenting a strong partisan argument. If he is to be successful, he must have not only good technical knowledge but also considerable ability in advertising and salesmanship in order that he may argue persuasively. His technical knowledge will show him a multitude of doubts on any appraisal problem which can be enlarged upon to support the special pleading which his client or employer may desire.

For example, exact costs are frequently very difficult to determine. Being human, he will enjoy the conflict that goes with work on one side of a valuation dispute; he will want his side to win. Yet he is supposed to do his work dispassionately in an atmosphere where partisan feeling runs very high, although he knows that the engineering societies have not yet found a way of selecting for signal honors those members who have shown preeminently their ability to stick up for an even-handed justice in appraisals. Being a successful engineer, he knows that a position as good as he has is not easily obtained, and so the temptation to do as he is requested is great. Sometimes he is required to make an appraisal report in perhaps two weeks on a property he has never seen before. Or his fee or appropriation may have been placed so low that, instead of making an appraisal, he is really making an "educated guess." Even when he wants to tell the truth and has the special ability to do so, a prospective client or employer will sometimes give the work to another engineer who is not properly qualified in the expectation that thus a higher valuation will be obtained. Yet it is only with facts correctly collected and intelligently interpreted that an engineer can do anything that will resist the assaults of the elements and time.

The Problem of Obsolescence—The most difficult problem that any engineer faces, however, in determining a valuation is the allowance to make for depreciation, including obsolescence. It is a most fruitful source of disagreement among engineers. By reason of insufficient time, too small a fee or ignorance as to the great extent of obsolescence, a condition may arise where glaring mistakes or willful misrepresentation may occur whose far-reaching effects can scarcely be estimated.

An engineer made an appraisal of various industrial properties, preliminary to their consolidation. His allowance for obsolescence was inadequate. Shortly after the consolidation many millions of dollars had to be spent for rehabilitation. Innocent investors suffered. Dissatisfaction developed all around so that the appraisal was condemned later in unqualified terms by representatives of the corporation.

The seriousness of the problem may be brought home by imagining an engineer retained to make an appraisal of the Ford Motor Company about five years ago in connection with its sale to a banking syndicate. At that time it earned very large profits. Five years later it had to spend many millions of dollars in rehabilitation. The New York *Times*, in December, 1927, quoted its officials as saying that five years before they had been aware that, in the end, such a revamping was going to be necessary. A very keen, analytical engineer with broad business knowledge might have sensed such a condition in connection with an appraisal made five years ago. Would he have had the courage to value the property accordingly, and if he had would the banking syndicate have given his report any consideration? These pertinent questions go to the very root of the service an engineer is obligated to give society. If he does not give it, he lacks courage or ability.

The Code of an Engineer—That many engineers are thinking seriously along these lines is revealed by a recent news item in the *Engineering News-Record*. It said that the American Institute of Consulting Engineers, at its anual meeting in New York on Jan. 16-17, 1928, had added to its code of ethics the following section: "It shall be considered unprofessional and inconsistent with honorable and dignified bearing for any member of the American Institute of Consulting Engineers:

"(14) To adopt, while serving as an expert witness before any court or tribunal, the attitude of an advocate or to express an opinion not founded on adequate knowledge and honest conviction."

Back of the preceding lies the thought expressed by the late Professor Sumner of Yale University, as quoted in the first volume of "Woodrow Wilson, Life and Letters," by Ray Stannard Baker. He said that we cannot argue under any conditions for any cause in which we do not honestly believe "without straining our sense of truth and losing the delicacy of our sense of right."

That some engineers do give this sort of unbiased service, based on conviction, is evidenced by a biographical sketch of Leonard Metcalf, written by Charles W. Sherman for the *Technology Review* of February, 1926. He quotes from the findings of H. M. Wright, master in the Spring Valley case, as follows: "His testimony shows not only an immense amount of labor in assembling materials for a judgment of value but a very evident desire on the part of the witness to exercise that judgment fairly and conservatively. This must be acknowledged whether we agree with his final opinion or not."

Mr. Sherman quotes further from a letter written to one of Mr. Metcalf's partners by Charles E. Gurney, chairman of the Maine Public Utilities Commission, as follows:

"Among the emoluments of my present position, more attractive to me than the financial return, are some of the men I have met, whose lives and achievements inspired my admiration and an endeavor to do my best work each day. None of them has impressed me more deeply for qualities of character, a manifest integrity and a steadying earnestness of purpose than Leonard Metcalf, of your firm. I always felt as he testified before this commission that there was no danger of his stultifying himself by making any statement in which he did not place implicit confidence. I felt that he would not exaggerate wantonly and that I could depend upon what he told me. I do not mean by this that I closed my mind and accepted his word as infallible, but I do mean I felt that so far as human error honestly made might be excluded Mr. Metcalf's word might be accepted and that he would not sell his opinion to the highest bidder."

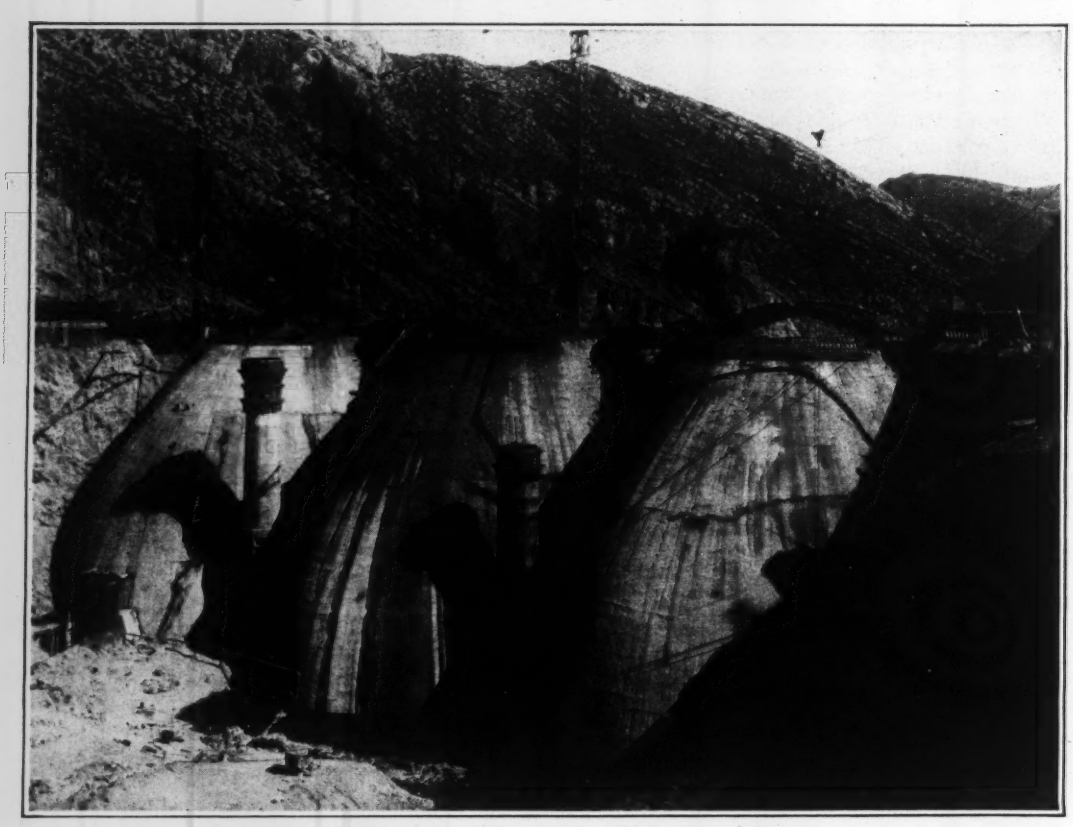
Old-fashioned honesty is not so common an attribute that society can afford to pass it unnoticed. We honor engineers for about every other conceivable thing. It would be a good idea if we made every effort to honor in a signal way the scientific spirit and honesty shown by the engineer who reports all the facts in order that the truth may be known.

Concrete Masonry Units in Tall Buildings

For the first time in the history of the building industry, according to the Portland Cement Association, concrete masonry units are being used throughout the entire construction of tall buildings. The structures in which these units are being used are the Integrity Trust Building and the Bouvier Apartments, both in Philadelphia. The Integrity Trust Building will, when completed, be 25 stories high and contain 350,000 cinder concrete units in addition to 1,000,000 concrete brick. The apartment building, which is to be a 23-story structure, will have cinder concrete masonry units for back-up and fireproofing. Approximately 165,000 masonry units and 1,150,000 concrete brick will be used in the exterior walls.

Construction Features, Coolidge Multiple-Dome Dam

Flexible Panel Forms for the Dome Supported by Novel Method, Overhung at 54 Deg. With Vertical—Spherical Dome Segments at Crest Carried on Trusses—Sequence of Dome Pours Simplified Construction



UPSTREAM CONSTRUCTION VIEW OF THE THREE DOMES
River control at left. Centering for two outer spans of roadway bridge in place. Intake towers not completed.

UNIQUE problems in concrete forming were solved with notable success in the construction of the Coolidge multiple-dome dam now being completed on the Gila River in Arizona. Despite the lack of precedent and the consequent necessity for pioneering, domes which involved curves in both horizontal and vertical planes were built true to design with smoothly finished surfaces by means of specially developed flexible form panels used practically without change throughout the job.

Either by panels or trusses successive tiers of forms were supported on parts of the work completed previously, so that the structure was at all times self-supporting without scaffolding of any sort. A record for government work is claimed in that the job was completed about nine months ahead of schedule. Its design was described in *Engineering News-Record*, Sept. 13, 1928, p. 396.

The contract was signed Jan. 1, 1927, under terms calling for completion by July 1, 1929, the contract price being $2,268,000 exclusive of steel and cement, which were furnished by the government. Excavation developed good rock foundation near the surface in the streambed, and under the buttresses the yardage underran the estimate. In the spillways, however, excavation exceeded the estimate about 50,000 cu.yd., and another 25,000 cu.yd. beyond the estimate was taken out at the dome buttresses in the side walls of the canyon. With these extras and the 10,000 cu.yd. of additional concrete necessitated by spillway changes, the ultimate cost of the job, involving a total of 201,000 cu.yd. of concrete, overran the estimate about 10 per cent. The total cost of dam and power house will be about $4,500,000.

Materials and Mixing Plant—Suitable materials for concrete aggregate were found in the streambed about a mile below the dam (Fig. 1). A crushing, washing and screening plant was installed there and delivery from its stock piles to a concrete mixing plant well up on the hillside above the dam was made by aerial tramway. This arrangement gave a cheap and dependable means of delivery without maintaining a bridge across the river for trucks. It also put the mixing plant beside the road convenient for receiving materials, well above flood danger and where it could chute directly to the distributing tower.

The mixing plant included two 2-cu.yd. batch mixers and was laid out on the basis of delivering 112 cu.yd. per hour. The usual concrete chute distribution system (Fig. 3), which reached all parts of the structure, was slung with slopes of 2 to 1 and 3 to 1, as necessary, and centered about a steel tower erected in the streambed.

The mix (described in the previous article) contained 1 bbl. of cement per cubic yard in the domes and about 0.9 bbl. per cubic yard in the buttresses. Roughly, the mix was 1:3:7 with some cobble rock up to 7-in. size. Where conditions in the forms made it desirable, 3 per cent by weight of diatomaceous silica was added to aid placement. As the work progressed the mixes were varied more or less to suit conditions, but always two sizes of rock were used and sometimes three.

The dam site is about 120 miles by road from Phoenix, Ariz., the nearest large city, and 8 miles from the nearest rail point, whence materials and supplies were trucked to the job. However, neither shortage of labor nor shortage of materials delayed the work materially, and progress was rapid from the start. At times there were 555 op-

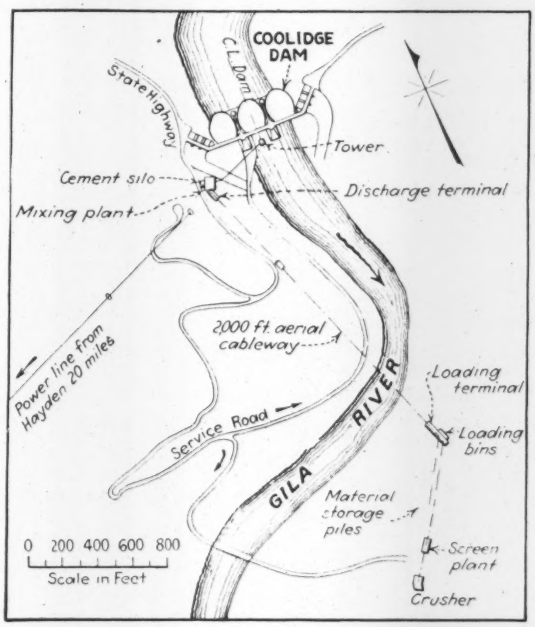


FIG. 1—MAP SHOWING CONSTRUCTION PLANT LAYOUT

eratives on the job with a total of about 650 men in camp. The first concrete was poured Nov. 25, 1927, and the maximum rate of placement was about 1,500 cu.yd. in sixteen hours. The maximum placement in one month was 35,000 cu.yd.

When the dam was between 100 ft. and 200 ft. above its base an average pouring rate of 1,100 cu.yd. per day was maintained for about 45 days. At that stage of the work this rate of pouring raised the dam about 2 ft. per day for its entire length. Two shifts were operated continuously throughout the job, with a third shift added for about one month during the period of river control.

Form Work for Domes—The buttresses offered no unusual construction problem, as panel forms held by struts and ties were carried up in the usual way. However, the speed with which the dam was built—and, in fact, the success of the construction plan as a whole—hinged on the problem of concrete forms for the domes. This problem was worked out on the basis of making the

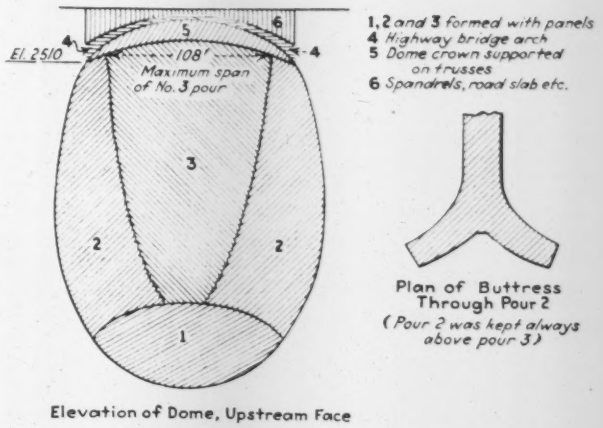

1, 2 and 3 formed with panels
4 Highway bridge arch
5 Dome crown supported on trusses
6 Spandrels, road slab etc.
El. 2510
108'
Maximum span of No. 3 pour
Plan of Buttress Through Pour 2
(Pour 2 was kept always above pour 3)
Elevation of Dome, Upstream Face

FIG. 2—SKETCH SHOWING SEQUENCE OF POURS IN DOMES

entire structure self-supporting, using flexible panel forms to shape the curves. By first building up in separate pours that portion of each arch element next to the buttresses, as shown in the sketch, Fig. 2, the later pours were arched across shorter spans. Another advantage in the advance side pouring was that in each arch element of the dome the last pour came at the crown, with the haunches well set and the construction joint between pours well out in that portion of the arch always under compression, thus lessening the danger of cracking. The side pours were stepped back with vertical faces to afford good bearing as well as bond.

Up to a level within 20 ft. of the top all concrete in domes and buttresses was formed with 4x8-ft. wood panels. Their construction was such that they could be quickly shaped to the varying warp of the surface in the domes and yet could be held in place firmly enough to secure a continuous and perfect curve. The secret of success in this was a panel made so flexible that it could be warped as easily as 1-in. boards can be bent.

These panels, which were used repeatedly on dome curves of different radii, consisted of three 2x6-in. rectangular frames held together by a facing of 1-in. boards.

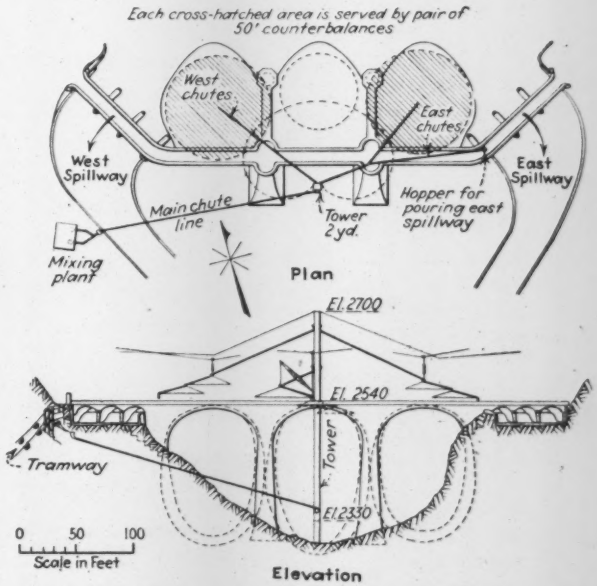
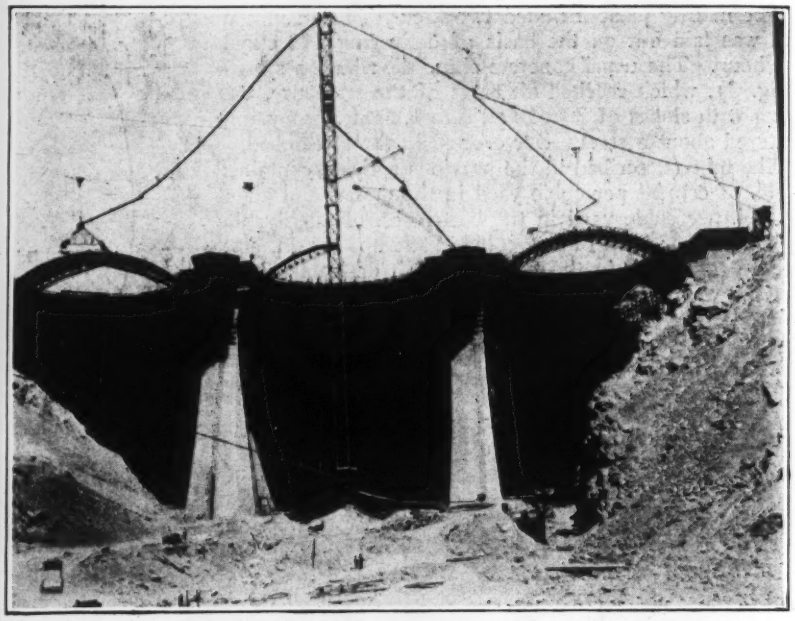


FIG. 3—CHUTING ARRANGEMENT FOR CONCRETE DISTRIBUTION

By making bevel cuts on the sides of the 2x6-in. studs, as shown in the sketch, Fig. 4, the panel was made flexible and could be deflected as much as necessary to fit the varying curves of the dome surface.

The panels were supported by the usual method of struts and ties up to a level of about 100 ft. above the base, where the overhang made an angle of about 30 deg. with the vertical. Here there was substituted a wishbone-and-walingpiece method of support for carrying the weight of the green concrete. This scheme was continued up to a point where the crown overhang was 54 deg. 53 min. with the vertical, beyond which trussed supports were used.

The wishbone consisted of a 1-in. steel rod bent into the shape of an inverted V (Fig. 4) and was used for panels on the intrados side only, panels on the outer curve being held in place by the usual strut-and-tie method. The two ends of the wishbone were embedded in the concrete soon after pouring. The spacing between wishbones varied from 8 ft. at the outset, where only one per panel was needed, to less than 3 ft. at the top where three per panel were used.



DOWNSTREAM CONSTRUCTION VIEW OF THE DAM
First unit of middle roadway arch centering in place. River channel almost dry. Domes are 254 ft. high; buttresses, 180 ft. center to center.

From each wishbone tie wires extended through the forms to an upper and a lower walingpiece, each of which consisted of two 2x4's, with flat sides toward the form panels, passing along the intrados in the position of a supporting arch rib. The panels were first slung in approximate position and then, as exact measurements were made from points set by transit, each panel was warped into exact shape, its bottom 2x6 was spiked to the panel below and the walingpieces were brought to the desired curve by wedges under the tie wires.

Instrument work on the domes involved setting a complete series of points marked by nailheads in the concrete on top of each successive 4-ft. pour. Getting the panels into exact alignment was greatly simplified by the use of a form gage (Fig. 5), with which points on the upper corners of the intrados panels were quickly located.

In preparing for a pour a set of three points marked by nailheads in the concrete was placed by transit crews every 4 or 5 ft. on the surface of the previous pour. The upstream or extrados point was located so that a plus reading marked on the panel beside it represented the distance vertically above the point to the upper edge of the panel when its base was spiked to the form below. The center or line point was located as a check, and the extrados point was set so that, when the form gage was made to read the vertical plus marked on the panel beside it, the tip of the gage arm would indicate the proper position for the upper edge of the next panel. This scheme, as indicated by the sketch, Fig. 5, involves only a vertical setting of the form gage, the length of the horizontal arm being fixed. The gage was graduated to tenths and a level bubble was used for plumbing.

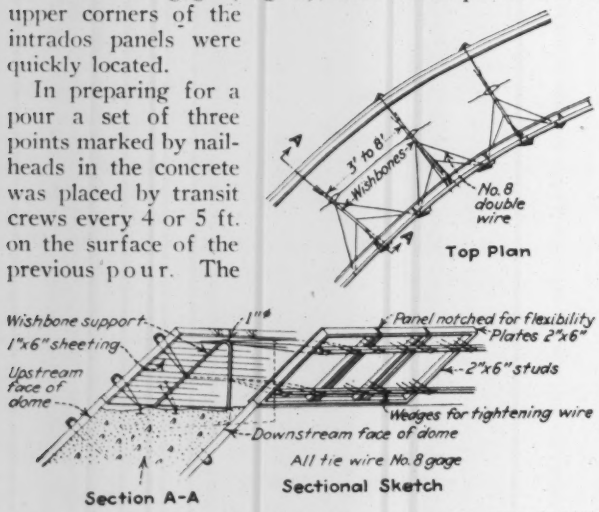


FIG. 4—SKETCH OF FLEXIBLE PANELS AND WISHBONE FORM SUPPORTS

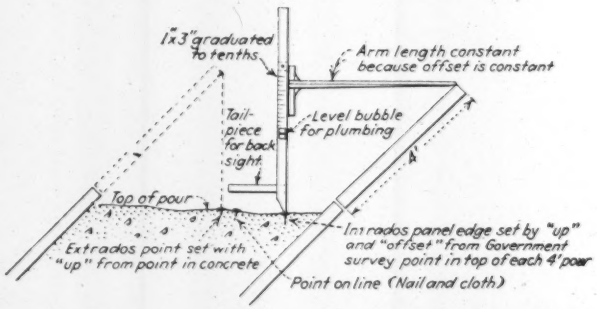

1"x3" graduated to tenths
Arm length constant because offset is constant
Tail-piece for back sight
Level bubble for plumbing
Top of pour
Intrados panel edge set by "up" and "offset" from Government survey point in top of each 4' pour
Extrados point set with "up" from point in concrete
Point on line (Nail and cloth)

FIG. 5—ADJUSTABLE FORM GAGE FOR SETTING PANELS

Working on the outer side of the intrados panels as they were being erected was extremely difficult until a simple scaffolding scheme was devised. This consisted of ending each 4-ft. pour 1 ft. below the full height of the panels instead of at the crest. Thus 4x4s laid on top of each pour could be thrust out through notches cut near the panel tops and when held down by tie wires would serve as cantilevered supports for planks at just the right height for the workmen who warped into shape and fastened the next tier of panels.

In stripping the dome forms it was found best to leave at least two panels below freshly poured concrete. This

PROGRESS IN BUILDING UP THE DOMES
Note advance pouring of haunches in each arch rib and deep abutment excavation in far hillside.

gave each layer a minimum of seven days to harden before its panels were deprived of actual bearing support on panels below. If there was closer stripping of preceding panels, the wishbone wire system was amply strong to prevent collapse, but the greatly increased strain caused stretching of wires with a resultant "finning" along the lower edge of the pour on the intrados, where the panels slipped downward slightly.

Highway Arch Construction—The 20-ft. highway across the top of the dam is carried over the three domes by concrete arches of 141.4 ft. clear span. Steel centering (Fig. 6) was used to support these arches during pouring, which was carried on simultaneously in all three spans. The steelwork consisted of three-hinged arches, of which there were four in each span, spaced 6½ ft. on centers and double crossbraced at panel points. The steel trusses were brought to the job in half lengths of 33-ft. sections and there, beneath the overhead cabling, were assembled into 16-ton units of two 66-ft. trusses weighing 16 tons. Each of these units, which reached from haunch to center pin, thus constituted one-quarter of the steelwork for each span.

The plan of erection was to place one unit at a time with the high line. When one end of the first unit was landed on its bearing plate and fastened there, the outer end was supported temporarily by a tie line to the canyon wall so as to release the overhead cableway for bringing up the second unit. When the two units were pinned together at the center, the process was repeated for the second pair. Ordinarily two units constituting one complete rib could be set in half a day. The top chords of these trusses supported timbering and blocking on which the concrete arch forms were laid and were given a camber to allow for settlement.

The pouring sequence in the arch was symmetrical about its center as indicated on the drawing. Sections 1 and 2 constitute the first pour; after three days the third section was poured, and then after a lapse of ten days more the crown and haunch sections (4 and 5) were put in simultaneously. The steel centering was designed to be lowered by cables passing through pipes embedded in the arches for that purpose. After the steelwork is disconnected and while it is being supported by the cables but before it is lowered all the way, it is to be held as swinging scaffolding and will be used by workmen to remove the falsework beneath the arches.

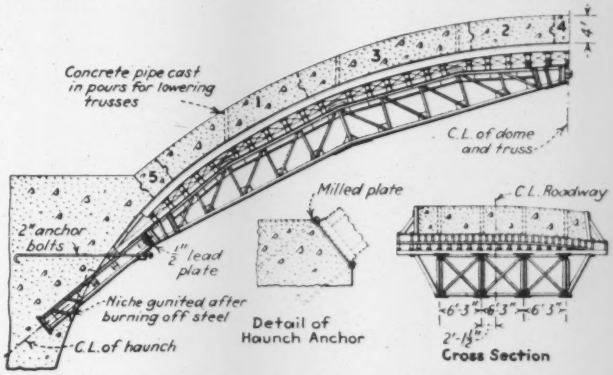
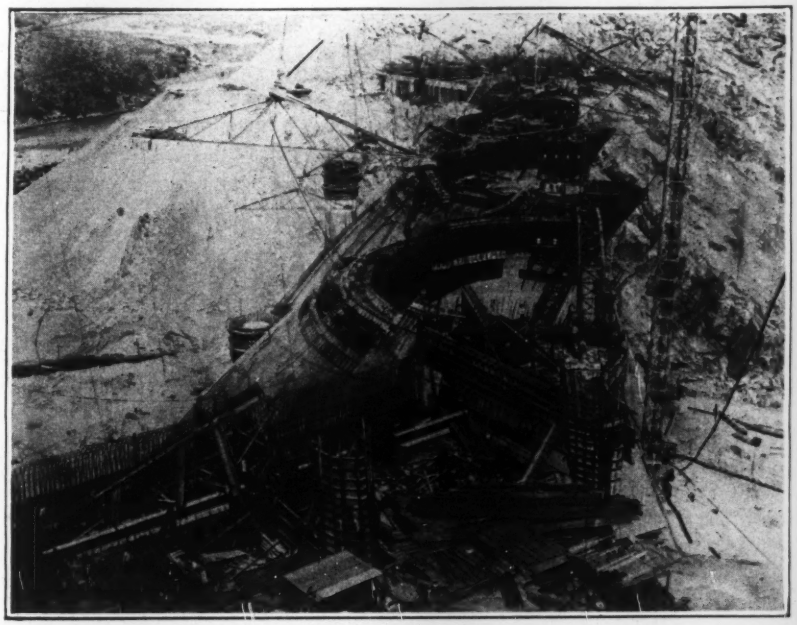


FIG. 6—STEEL TRUSSES USED FOR ROADWAY ARCH CENTERING

Forms for Dome Crown—Forms for the upper part of each dome, extending from the crest to a level about 20 ft. below, at which point the use of panel forms was discontinued, were supported by timber bowstring trusses placed normal to the dam center line. The ends of these trusses were carried on underslung supports, the lower end on double 1½-in. stirrups projecting downward on the under side of the dome and the upper end from bars extending down from the roadway arch. In each dome 22 of these timber trusses were used, the two longest being 55 ft. in length and the spacing varying from 3 to 5 ft. to suit the crownpouring schedule.

When these trusses were placed the dome concrete below had already set, so the lower truss ends were landed directly in the stirrup. The upper ends were rested, for the time being, on the bottom chord of the steel centering of the roadway arch. U-bolts embedded in the roadway arches car-



LOOKING EASTWARD ACROSS THE TOPS OF THE DOMES
Intrades panel forms supported by wishbones. Steel in foreground marks west spillway lip. Erection of roadway centering under way.

ried threads at their lower ends to facilitate connection with sleeves and turnbuckles on the timber trusses. When the roadway arches had aged about three weeks it was necessary only to thread the sleeves and take up on the turnbuckles slightly in order to transfer the bearing from the steel centering directly into the concrete arch.

On the timber trusses shaping ribs were laid and by means of wedges were brought up to exact grade as determined by instrument, with camber to allow for settlement under load. Laminated 3x8-in. carrying joists followed, placed on 1-ft. centers transversely to the trusses, and finally 1-in. sheathing was nailed on.

Pouring this truss-supported portion of each dome, which constituted a true spherical segment, had to be done in sections, and it was desirable to arrange the sequence of pourings so as (1) to balance the loading in

LOOKING DOWN FROM CABLEWAY ON CREST OF DOMES
In foreground boards are being placed as final layer of truss-supported forms.

elements of the dome considered as arch ribs normal to the spring line at the buttresses; (2) to pour each of these arch ribs in sections with the crown last; (3) to make each arch rib self-supporting before the next one was completed and (4) to avoid extremes either way in the hydrostatic head on each pour. To meet all these requirements it was necessary to allow twenty days for completing the system of interlocking successive pours.

Because tamping was impracticable due to the five layers of steel in this part of the dome, of which three were placed diagonally, it was desirable to have each part of every pour under a hydrostatic head of not less than 2 ft. Where necessary collars or risers were built up around the pouring openings, and after pouring these were left full to maintain the head. The maximum head, on the other hand, was 14 ft.

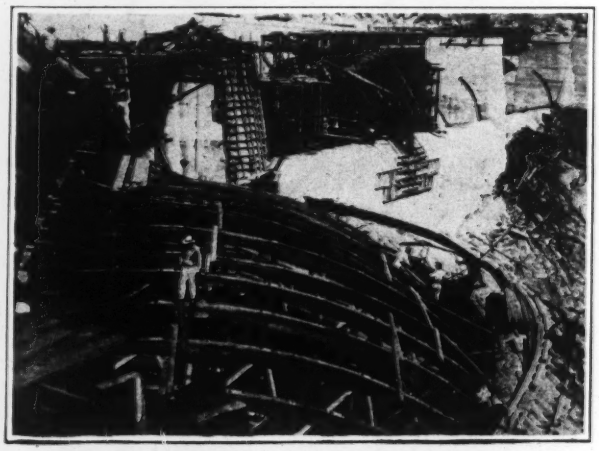
Because of the high temperatures and the extreme aridity of the air, it was found desirable to wet down the wood forms with a hose twice daily regardless of how long the forms were to stand before pouring. In the absence of this frequent wetting, 1-in. boards would dry, warp and crack.

To insure a pleasing finish free from form marks on the upstream faces of the domes and as an additional precaution against leakage, a 1½-in. coating of gunite

LAMINATED CARRYING JOISTS SPACED 1 FT. APART, ON THE TRUSSES
Above and to the right 1-in. sheathing is being placed. Temperature steel is projecting from the dome in right foreground.

was put on some time after the forms were stripped. Embedded in this gunite is a layer of wire mesh laid in 4-ft. widths and held away from too close contact with the face of the dome by ¾-in. concrete blocks fastened on the under side of the mesh. The gunite was applied by an operator standing on the face of the dome but supported in a rope sling from the dam crest. Hose lengths at times were as much as 300 ft. between gun and delivery nozzle, with head differences exceeding 200 ft.

Construction Organization—The dam was designed for the U. S. Indian Service under the direction of Major C. R. Olberg, who has been in charge since construction began. The contractor is the Atkinson, Kier Bros. & Spicer Company, for which E. L. Kier is resident co-partner in charge. J. G. Tripp, general superintendent since the death of his predecessor, E. A. Wright, took charge at the commencement of river control. Mr. Tripp designed the concrete-placing layout, developed details of formwork and the construction plan generally. Charles G. Clapp is assistant superintendent and Henry Algert is engineer for the contractors. J. C. Moore, in charge of all carpenter work, gave valuable help on form details, and Huso Festich, superintendent of excavation, is in charge of all labor. The contractors stress the fact that "co-operation of the government engineers has been a large factor in progress on the job."



BOWSTRING TRUSSES FOR CROWN OF WEST DOME
Upper limit of panel-supported pours in right foreground. Forms for roadway arch at left. West spillway in background.

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

Melan on Steel Bridges

REVIEWED BY D. B. STEINMAN
Consulting Engineer, New York City

DER BRÜCKENBAU Nach Vorträgen gehalten an der deutschen Hochschule in Prag—Von Dr.-Ing e.h. Joseph Melan, Hofrat, o.ö. Professor des Brückenbaues. III Band, 1 Hälfte, Eiserne Brucken, 1 Teil. Dritte, neu bearbeitete und erweiterte Auflage. Leipzig und Wien: Franz Deuticke. Paper; 7x10 in.; pp. 521; 572 line cuts. 26 reichsmarks, in Germany.

A wealth of material of interest to the bridge designer is given in Professor Melan's Steel Bridges, which now appears in its third edition, revised and enlarged. The book is the third volume of the author's noteworthy series on Bridge Construction. It differs from the usual American textbooks in that it does not treat theoretical analysis and practical application separately but combines the two in its presentation. In the successive editions, Professor Melan (now 75 years old) has kept abreast of the latest developments in research and standards while recording the fruits of a lifetime devoted to original work and study in the field of bridge design. The volume is generously illustrated, including numerous clear reproductions of design details.

The first chapter is devoted to the materials and elements of steel structures. It covers the physical and chemical properties and the metallurgy of the various structural and alloy steels; the standard rolled sections; and an analysis of connections by rivets, bolts and pins. The outline of specifications for the different grades of steel includes American as well as European standards. The specifications for the material used in the Hell Gate arch bridge have been included, also those for the German "Steel 48" which is becoming the generally adopted material for large bridges on the continent of Europe. A section describing the standard fabricating shop processes has been added, covering the operations of straightening, bending, cutting, milling, punching, boring, reaming and assembling.

Chapter II deals with design stresses and loadings, under such headings as fundamental principles, secondary stresses and other variations from calculated stress, working unit stresses, various specifications for live loads and impact, and column theory and formulas. In discussing the governing principles for the selection of design stresses, Melan states that it would be permissible to go to the elastic limit if it were possible to predetermine the absolute maximum stress in each member. A section on the measurement of stresses and deflections has been added, describing and illustrating the various types of instruments used; the stress measurements on the Hell Gate arch and those of the Swiss Federal Railroads in 1917-23 are summarized, and the results of various impact measurements (including those of the American Railway Engineering Association, the Indian Bridge Commission and the German Railroad) are plotted and compared. The various column formulas presented and discussed include those of Euler, Karman, Vierendeel, Krohn, Ostenfeld, Tetmajer, Bleich and Engesser, also various methods for figuring columns of varying *I*.

The third chapter covers the design and details of riveted connections, splices and plate girders. An illustrated discussion of strain distribution in gusset plates and other riveted connections has been added, based principally on the recent experiments of Wyss (Zurich).

Chapter IV is devoted to bridge floor construction. Designs and details of various types of roadway deck and floor systems for both highway and railway bridges are described and illustrated. Relative weights and economy of different types and layouts are discussed. The treatments for skew bridges and those on curve are also presented. An illustrated section on footwalks, railing design and maintenance staging is included. The sections on the calculation of buckle plates, concrete slabs and continuous stringers have been amplified, and design tables have been added.

The final chapter deals with the design of the main trusses, under the subheadings of truss systems, forms of simple trusses, analysis of trusses, secondary stresses, make-up of sections of members, safety of unbraced chords against buckling, panel-point connections, chord splices and end bearings. The section on Vierendeel trusses has been extended to include trusses with curved chords. A new section deals very thoroughly with the question of the buckling resistance of compression chords, wherein formulas are derived for the frame-resistance of the different types of cross-section of through bridges. The section on details has been enlarged; the new illustrations of gusset connections and bearings include examples from the Sciotoville bridge and other American designs.

This treatise on steel bridges can be studied with profit by practicing engineers as well as by students of the subject.

A Brief Against Private Power Control

POWER CONTROL—By H. S. Raushenbush and Harry W. Laidler. New York: New Republic. Paper; 5x8 in.; pp. 298. $1 postpaid.

In this a well-written brief against private control of hydro-electric power, the partisanship is less extreme than that shown by some of its citations from opponents of municipal ownership, one or two of which defeat their ends by their silliness.

The topics of the book are Propaganda; Technique; Concentration of Control; Rates; Regulation—Our Lost Province; The Enemies of the People (sarcasm directed against those who so characterize supporters of public ownership); Across the Border; The Annoying Anglo-Saxons (relating to the Ontario Hydro Electric Commission); Meters and Measuring Sticks (a plea for public ownership and operation of power plants on the Colorado River [Boulder dam], the St. Lawrence and at Muscle Shoals, to show by the low prices under public control how excessive are the profits under private ownership); and the Recapture of Control.

The chapter on Regulation—Our Lost Province, reflects the widely spread opinion that the state utility commissions betray their trust and serve the utility companies rather than the people. One reason for this, the authors maintain, is that the members of the commis-

sions have learned by observation that that way lie highly paid positions with the utility companies—or their publicity agents. The authors protest against the use of present high costs as a means of determining the rate base in place of actual investment and point out what appears to them to be a halting and vacillating policy of the United States Supreme Court in this respect, through ruling for reproduction cost in theory and allowing but part of it in practice, even in the famous Indianapolis Water Company decision.

Whatever one's opinions on the subject of this book, the volume is well worth reading. It reflects the deep concern of many over what they consider to be the menace of a rapidly growing monopoly of power, made all the more dangerous, they believe, by commission and court rulings that allow the utility companies to earn high dividends on what they consider to be inflated values, based on reproduction—new rather than actual investments. It is because of belief in this menace that the authors urge public ownership of such proposed hydro-electric projects as the Colorado, the St. Lawrence and Muscle Shoals, to provide "meters or measuring sticks" of the cost of power.

"A Layman's Review for Laymen"

THE AMERICAN ARCHITECTURE OF TODAY—By G. H. Edgell, Professor of Fine Arts and Dean of the Faculty of Architecture, Harvard University. New York and London: Charles Scribner's Sons. Cloth; 7x9 in.; pp. 401; 374 halftones. $6.

If any class of men outside of architects needs to know something about the best architecture of the day in this country, it is engineers. Why? Because their work continually calls for the design of structures which may be blots or ornaments upon the landscape according to whether the essentials of good architecture are ignored or followed. This book, characterized by the author as a "layman's review for laymen," passes in review the development of American architecture, and three main classes of its product: Domestic and academic, ecclesiastical and monumental, and commercial architecture. As it is devoted to good rather than to bad examples, and points out in what the goodness consists, and is fully illustrated, it is admirably adapted to its purpose, which is to form good taste in architecture—for which, in architecture, and all the other liberal arts, there is nothing like an acquaintance with good examples. Such an acquaintance among engineers would greatly improve the looks of the structures they design, either directly or by leading them to obtain more often than they do the co-operation of architects.

In his section on commercial buildings the author says:

> If an engineer, meeting a special problem in a purely scientific way, produces a building of beauty, he has produced architecture. He may do so unconsciously, he may even resent the implication that he has done it at all, but he cannot escape the fact. This does not mean that all factories are beautiful. Alas, the great majority of them are hideous, but there remain many, designed by engineers, by engineers and architects associated, and even by great architects in full control, which have the element of beauty as well as practicality and which we can be proud to include in the category of American architecture. . . . One of the most important functions of an architect is to plan ingeniously to meet special conditions and if an engineer does this in a building, he becomes—temporarily at least—an architect.

Following these remarks a number of bridges and other structural works, designed by engineers alone or with architects associated, are described and illustrated. Certainly the remarks cited and the examples illustrated should encourage those engineers who realize artistic possibilities in their work, and should stimulate others, particularly the younger engineers, to give them consideration. This book will be a great help to that end—through text, excellent halftones and an extensive bibliography. Its great lack is an index, but that is partly made up by a classified list of monuments, arranged alphabetically under each class, with page references to text and illustrations.

Primarily for the Chemist

REVIEWED BY WELLINGTON DONALDSON
Of Fuller & McClintock, Consulting Engineers, New York City

THE CHEMISTRY OF WATER AND SEWAGE TREATMENT—By Arthur M. Buswell, Chief, Illinois State Water Survey; Professor of Sanitary Chemistry, University of Illinois. [American Chemical Society Monograph Series.] New York: Book Department, The Chemical Catalog Co. Cloth; 6x9 in.; pp. 362; 58 line cuts and halftones; 47 tables. $7.

The value of any technical book is best judged by its stated aims and purposes. The present work is one of a series of 74 scientific and technological monographs sponsored by the American Chemical Society in accordance with an international agreement with other scientific bodies. These monographs are directed mainly to the information of chemists, but the author in his preface indicates an appeal to engineers as well. He disclaims any attempt to discuss mechanical and operating details or analytical methods, and he believes that his work is unique in dealing solely with the chemistry of water and sewage treatment in a single volume.

An examination of the contents of the monograph shows that the stated aims have been very fairly met. The book should not be considered as supplanting in one's library some of the well-known texts which deal comprehensively with water purification on the one hand or with sewage treatment on the other, although in its scope it necessarily overlaps both fields. The particular merit of the book is that it gives a fresh and vigorous discussion of the properties of water and sewage and the underlying principles and theories of purification methods from a new angle. To the chemist the work is valuable on account of the lucid explanation of processes in terms which the chemist is accustomed to use. To the engineer the work is valuable for its sidelight on methods familiar to him but regarding the fundamentals of which knowledge in some cases has been meager. The work embodies as assemblage of considerable recent research work available only in scattered form in periodicals. References to the literature are copious.

The text proper consists of 338 pp. divided into 22 chapters. Fifty-eight pages are devoted to a discussion of general chemical theories; 144 to water properties and water treatment; and 151 to the characteristics and treatment of sewage. Under both water and sewage the development of the subject matter is carried out logically, although the arrangement and captions of the chapter divisions are not free from fault. For instance, the excellent discussions of water softening are handled under the designation Industrial Water Treatment. This seems arbitrary in view of the steadily increasing number of municipal water-softening plants, three of which are illustrated in the text. The funds for the building of municipal softening plants are obtained not on the plea of their benefit to local industries but on the basis of direct benefit to domestic consumers. Again, the grouping of Filtration and Disinfection in one chapter is justi-

fied only by the limited number of pages devoted to these subjects. Furthermore, the discussion of iron removal and prevention of corrosion might be more appropriately discussed under Water for Domestic Use than in a special chapter devoted principally to boiler treatment.

In the section on sewage all of the so-called aerobic or oxidizing processes are dealt with under Removal of Colloids. This conception is not objectionable but apparently has led the author into the error of assuming that having removed colloids the job is finished. On the contrary, the bacterial quality of sewage effluents is frequently of more importance than physical and chemical qualities. Chlorination of sewage effluents is widely practiced, yet the author makes no mention of sewage disinfection, except in a tabular outline of methods.

The author shows a tendency to give undue emphasis to novel though little used processes; for instance, the Peuch-Chaval impregnated and drifting sand filters. In discussing the activated-sludge process, considerable space and illustration are given to forms of aerator of little or no importance in practice, whereas there is conspicuous omission in text and illustration of the plate-diffuser method employed in the majority of plants, both here and abroad. The same might be said of Automatic Sludge Return.

The numerous illustrations are in general well chosen, although not always keyed into the text. The water plants illustrated are mostly small and little known installations. In giving photographs of actual plants, it would seem desirable to identify the plant by name, as for instance the Pasadena activated-sludge plant (Fig. 42).

There are very few typographical errors in the book. One of importance is on p. 135, where the salt ratio for regeneration of zeolite is stated as ½ lb. of salt per kilogram of hardness removed. Obviously "kilograin" is meant, as this coined form is sometimes used in place of 1,000 grains. For the sake of historical accuracy, Winnipeg, Man., instead of Owensboro, Ky. (p. 120) should be credited with priority in use of recarbonation of softened water.

Rural People, Conditions and Problems

ELEMENTS OF RURAL SOCIOLOGY—By Newell Leroy Sims, Professor of Sociology in Oberlin College. Author of "Society and Its Surplus," etc. [Crowell's Social Science Series. Edited by Seba Eldridge, University of Kansas.] New York: Thomas Y. Crowell Co. Cloth; 5x8 in.; pp. 698; numerous illustrations. $3.75.

On the U. S. Census basis of 2,500 population as the dividing line between urban and rural population there were, in 1920, 51,400,000 ruralites in the United States, or 48.6 per cent of the total population of the country. These figures alone are sufficient to warrant a comprehensive volume on Rural Sociology. It is by no means the first book on the subject, but the author gives as his reason for writing that he approaches the problems considered from the urban viewpoint. This he has been led to do because in his experience a large majority of the students in rural sociology "are of town or city origin." This is significant at a time when the urban population is outnumbering the rural. The book is timely when, just at the eve of a presidential election, declarations are frequently made that from now on the cities are to dominate the country and when the problems of the farmer are a storm center in politics.

The body of the book is in four parts, dealing with the vital element, the rural people themselves, and the cultural, material and structural elements. Under culture, among other topics, the farm home, rural schools, churches and recreation, and rural health and sanitation are considered. The structural element includes chapters on ancient, colonial and present-day community life, the country village, planned communities, co-operative associations and rural organizations in general.

The author has handled his subject admirably, producing a book of interest and value to the general reader, in city and country alike, as well as for school and college use.

On Engineering and Allied Topics

ENGINEERING EDUCATION: Essays for English—Selected and Edited by Ray Palmer Baker, Ph.D., Professor of English and Head of the Department of Arts, Science and Business Administration, Rensselaer Polytechnic Institute. Second Edition, Revised and Reset. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6x8 in.; pp. 233. $2.

Although selected for use "chiefly in elementary courses in exposition," the fourteen essays composing this book are well worth reading by other than engineering students. In the present edition some new essays appear. The plan still is to present essays on current problems by distinguished authors, the subjects dealing with various phases of "science and society." More specifically, most of the fourteen essays deal, somewhat broadly, with education in engineering and allied sciences, or with the sciences as bearing on education. The first edition was noted in these columns Nov. 13, 1919.

Economic Value of Human Life

HEALTH AND WEALTH: A Survey of the Economics of World Health—By Dr. Louis I. Dublin, Ph.D. Statistician, Metropolitan Life Insurance Company. New York and London: Harper & Brothers. Cloth; 6x9 in.; pp. 361; some line cuts. $3.

Few writers are so happily facile in dealing with statistics as Dr. Dublin. Add to this the messages that he conveys on two such vital subjects as health and wealth and this series of essays is well designed to have a wide appeal. The first three chapters deal with The Economics of World Health, in which is considered, among other things, the cost of raising a child, the value of a man, losses due to sickness and to death and the international viewpoint; The Cost of Medical Service—now almost prohibitive except to the rich and to the many of the poor who get free service; and What It Costs to Neglect Our Children. Next, consideration is given to three specific diseases—heart, tuberculosis and cancer. Then Old Age is ably discussed. Other chapters that will be mentioned take up the True Rate of Natural Increase, Life, Death and the Negro, Health of the Workers, Has Prohibition Improved Public Health, and the Possibility of Extending Human Life. Optimism is the note on which the whole book is written, but an optimism founded on keen statistical analysis, common sense and a belief that with facts carried home more liberal funds to combat ill health and disease, and thus to prolong life, will be provided.

Revised and Much Enlarged

ENGINEERING CHEMISTRY: A Manual of Physical Testing and Quantitative Chemical Analysis for the Use of Students, Chemists and Engineers—Sixth Edition. By Thomas B. Stillman, Late Professor of Engineering Chemistry at the Stevens Institute of Technology; Revised and Enlarged by Albert L. Stillman, Special Lecturer, Fuel Engineering Course, Towne Scientific School, University of Pennsylvania. Easton, Pa.: The Chemical Publishing Company. Cloth; 6x9 in.; pp. 1093; 235 illustrations. $12.50.

Successive revisions have greatly enlarged and improved this book since its first appearance in 1895. The fifth edition (see *Engineering News*, Feb. 15, 1917, p. 278) contained 760 pp. and 150 illustrations, compared

with the figures given above for the present edition. How the new matter has been distributed the Preface to the new edition does not state. Principal materials taken up are: ores; stone; clay, brick and cement; metals and alloys; solid fuels, gas, oils or liquid hydrocarbons; soap, cleaning compounds and grease; paint and varnish; water; paper. Air, sewage and milk are not included. Under water analysis such reference as is made to the Standard Methods of Water Analysis of the American Public Health Association and co-operating organizations gives no adequate idea of the scope of that publication. An outstanding feature of the volume, it may be noted in conclusion, is that, as its sub-title indicates, physical testing as well as chemical examination is taken up.

Publications Received

INFORMATION regarding the various national parks is given in a series of illustrated pamphlets issued by the National Parks Service, Department of the Interior, Washington, D. C.

THE HIGHWAY LAW of the State of New York, together with the Public Works Law, General Highway Traffic Law, and various special acts in force in 1928 has been issued as a 540-p. volume by the State Department of Public Works, Albany, N. Y.

STREAM FLOW RECORDS FOR PENNSYLVANIA, covering the water years ended Sept. 30, 1924, and Sept. 30, 1925, are now available in separate bound volumes of about 200 pp. each, compiled by Water Resources Service, Department of Forests and Waters, Harrisburg, Pa.

PROCEEDINGS of the Annual Conference of the Maryland Water and Sewage Association, 1928, contain many papers and discussions on the subject indicated by the name of the association, and are available in mimeographed form for $1, sent to T. C. Schaetzle, 2411 North Charles St., Baltimore, Mo.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

ÄSTHETIK IM BRÜCKENBAU Unter Besonderer Berüksichtigung der Eisenbrücken—Von Dr. Ing. Friedrich Hartmann, ord. Professor der Technischen Hochschule in Wien, Leipzig and Wien: Franz Deuticke. Paper or cloth; 7x10 in.; pp. 148; 117 illustrations, mostly halftones. Price in Germany, 15 marks in paper; 17.5 marks, bound.

DIE BAUKONTROLLE BEIM GUSSBETON EIN TASCHENBUCH FÜR DIE BAUSTELLE—By Dip.-Ing. Oskar Spetzler and Regierungsbaumeister Helmut Möhle Ruhrverband Essen. Berlin: Wilhelm Ernst & Sohn. Paper; 5x7 in.; pp. 56; 32 halftones and line cuts. 260 Reichmarks.

BEITRAG ZUR BERECHNUNG STATISCH UNBESTIMMTER FACHWERKE—By Dr. H. Heimann. Berlin: Julius Springer. Paper; 6x9 in.; pp. 24; 20 illustrations. 2.5 marks.

GALLIO: OR THE TYRANNY OF SCIENCE—By J. W. N. Sullivan. New York: E. P. Dutton & Co. Cloth; 4x6 in. pp. 57. $1.

HANDBUCH DER WASSERVESORGUNG—Von Professor Erwin gross, Abteilungsleiter der Landesaustalb für Wasser—Boden- und Lufthygiene in Berlin—Dahlem. Munich and Berlin: R. Oldenbourgh. Cloth; 6x9 in.; pp. 427; 187 illustrations. 22 marks in Germany.

HYDROGRAPHIC MANUAL—By J. H. Hawley, Hydrographic Engineer, U. S. Coast and Geodetic Survey. Paper; 6x9 in.; pp. 170; illustrated. 45c. from Superintendent of Documents, Washington, D. C.

Covers practice, instruments used and other matters pertinent to the hydrographic work of Coast and Geodetic Survey.

McGRAW CENTRAL STATION DIRECTORY, 1928—New York: McGraw-Hill Catalog & Directory Co., Inc. Cloth; 5x8 in.; pp. 946. *$25.

Covers electric light and power plants of United States and Possessions, Canada, Newfoundland, Central and South America, Bermuda Islands, West Indies. Gives information on some 150 holding and 4,000 operating companies and 4,500 plants; lists 12,000 managerial and operating officials. All "towns" over 250 population are listed, both alphabetically, by states and under their respective operating companies; contains directory of state utility commissions, with names of commissioners and staff and index of companies and city-owned plants. Has no summaries, except as stated above.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Divergent Views on Construction Safety Code

FEW PROBLEMS have come before the American Engineering Standards Committee which call for more calm judgment than the problems of directing the creation of a code of safe practices in construction. The genesis of this task and some of the considerations which it seemed to us should govern its performance were outlined in *Engineering News-Record*, Aug. 2, 1928, p. 155, and Aug. 16, 1928, p. 230. Commentary on these editorials and, more importantly, on the problem of construction safety, is contained in the following letters from prominent persons and agencies interested in accident prevention. —EDITOR.

Sir—The National Safety Council, the leading organization on safety in the country, has grown to its present usefulness through co-operation and education.

Any formula relating to accident prevention in construction which contains the mandatory "you shall" and "you must" cannot be enforced except by enactment into law. Such enactment into law immediately releases the contractor and his affiliations from the responsibility of carrying on individual and co-operative accident prevention and shifts the responsibility to the state.

Unlike safety regulations in industrial work, where conditions are fairly constant, and the problem simplified thereby, construction presents continually varying conditions. Therefore we do not believe that state enforcement can be effective in preventing accidents in construction in anything like the degree that it has been successful in industrial plant work. Meanwhile there has been lost to the cause the only real and practical instrument for preventing accidents—the general contractor.

If any formula is eventually built up through the efforts of the A.E.S.C. and those organizations which have so far taken part in the present movement, we believe that to be successful it must be built up on two primary premises.

First—There must be an absolute absence of mandatory language and tone intent, and the structure must be reasonable and co-operative in spirit.

Second—Even in the face of arguments made with good intent, it must be realized that the general and sub-contractors are the ones, and the only ones, who are in possession of first-hand practical knowledge from which to draw up really workable suggestions. Any other views than this must surely lead to defeat.

The membership of our association is heartily in sympathy with any move that will materially help a safety program, but we are sure that more can be accomplished by the co-operation of the various bodies now practicing accident prevention, which are working along lines similar to ours, than by raising dissension by trying to domineer the situation with a mandatory code.

W. R. RICHARDS,
Director, Safety Department,
Associated General Contractors.

Washington, D. C.,
Aug. 8, 1928.

Sir—Referring to the editorial Safety in Construction: I think your observations and questions are very much to the point in so far as the reference to contractors is to the type represented by the Associated General Contractors. Unfortunately for the workmen, not all are of that type and cannot be depended upon to inaugurate or carry on such safety practices as are reasonable. It will be unfortunate indeed if it becomes necessary to have safety in construction by statute, because there can be no one best way defined by law to accomplish a given piece of construction with safety.

It would be preferable to have a high sense of moral responsibility developed in the personnel engaged in super-

vising such work, thereby avoiding artificial restrictions that are bound to hamper the honest contractor, while the effect on the dishonest may be negligible.

The committee is in need of the best thought in formulating and putting into effect a worthy code.

Washington, D. C.
Aug. 16, 1928.

NOLAN D. MITCHELL,
U. S. Bureau of Standards.

Sir—As a delegate to the American Engineering Standards Committee on this subject you may rest assured that our interest in the matter is gaining and we fully appreciate the seriousness of the undertaking that is being attempted. We thoroughly sympathize with the conclusion that you formed and we believe that the American Engineering Standards Committee on the construction safety code will do its best to produce an equitable instrument for accident prevention in this hazardous industry.

G. V. FULLER,
Assistant Secretary,
National Council of Compensation Insurance.

New York, N. Y.,
Aug. 13, 1928.

Sir—I have read the editorial with interest and consider it a comprehensive statement of the situation, although I cannot agree that "the recent conference was dominated by labor commissioners and casualty insurance officials."

All signs appear to point to the adoption of safety codes by legislative enactment in the interest of better protection for the workers, and I believe the opportunity is now offered, through the co-operation of all the interests affected, to formulate a reasonable standard which would no doubt serve as a guide for any legislative requirements which may follow.

New York, N. Y.,
Aug. 8, 1928.

THEODORE I. COE,
Architect.

Sir—It may interest you to know that my personal feelings in the matter are identical with the expressions in your editorial. I am heartily in favor of the work of the committee if it is done with the co-operation of the contracting element of the industry. Regardless of the objections to a code, good only can come from it if we continue along the lines of effort that are being followed by the contractors.

JOHN G. AHLERS,
Barney-Ahlers Construction Corporation.

New York, N. Y.,
Aug. 10, 1928.

Sir—I have read the editorial on the task of the special codes committee and the American Engineering Standards Committee relative to safe practices on construction work. I am certainly familiar with the task that confronts this committee, having been a member of the previous committee of the National Safety Council.

There are many points that will have to be given most careful consideration, and to my mind the main effort should be along the lines of safe practices through educational methods and there should be standard safety regulations adopted that can be printed and posted in every building in which construction is going on.

As a member of the committee on engineering standards I intend to give a very careful study to the recommendations made to this committee and it shall be my endeavor to handle such recommendations in the most practical way. Having been in charge of the structural work of the state department of labor of New Jersey for the past fifteen years and being a construction man myself, I think I am in a position to offer practical suggestions regarding building construction.

Trenton, N. J.
Aug. 17, 1928.

CHARLES H. WEEKS,
Deputy Commissioner of Labor.

Sir—I appreciate the difficult job which is ahead of this committee, but without doubt it is the most important code which can be developed by the American Engineering Standards Committee for use in the construction industry.

It is true that the majority of those who attended the conference in New York were representatives of labor departments and insurance company representatives. There is nobody in a better position to know the necessity for regulations covering the construction industry than these two groups, in view of the fact that they are in daily contact with accident records. No one who has been connected with the accident prevention movement can help but disagree with the claims made at that meeting by the contractors' representatives that the development of regulations would hinder the safety work which is being carried on. The contracting industry is no different from any other industry as far as accident prevention work is concerned, and to say that safety codes have been a hindrance to other industries in their accident prevention programs would be absolutely contrary to fact.

Regulation and education go hand in hand and there is absolutely no conflict between the two phases of accident prevention work.

There are thousands of so-called contractors who have no connection with any contractors' association such as the Associated General Contractors of America and who would never be reached by any accident prevention policy which might be inaugurated by such associations. This group, even though composed of contractors who do not employ a large number and do not have many accidents per year per contractor but who in the sum total compose a group producing at least 75 per cent of the accidents, must of necessity be reached first through enforcement of safety regulations.

The contracting industry as a whole has been absolutely lax in connection with accident prevention work up to the past two years, and that is the reason why insurance companies and state organizations are so interested in seeing that some definite accident prevention policy is established in the industry. Code development with proper enforcement does produce safety and we appreciate as much as the contractors themselves that it will not produce 100 per cent safety and that education must go along with it.

Harrisburg, Pa.,
Sept. 5, 1928.

CYRIL AINSWORTH,
Director, Bureau of Industrial Standards.

Sir—The editorial "Safety in Construction—Shall It Be by Code?" in which is discussed the seriousness of the work ahead of the American Engineering Standards Committee in the preparation of a national safety code to be used in building construction, has been read with interest.

Your article seems a bit ambiguous in that it refers to a construction code rather than a code on the erection, repair and demolition of buildings in relation to accident hazards to employees and to the public, to differentiate it from other classes of construction and from hazards to employees alone.

Your article tended to leave the general impression that politicians would seize upon such a code and advocate legislative enactments based thereon, to their own aggrandizement, creating a vicious situation which would work a hardship on the contractor, but, regardless of that, the work was to be carried on because the "conference was dominated by labor commissioners and insurance officials." Such was not my impression.

The Associated General Contractors through its representative stated why contractors were not in favor of a code, and labor officials, backed by labor, stated their arguments for the affirmative. Dr. Stewart said that in view of the delays in the American Engineering Standards Committee's code work legislative enactment might be quicker; that if co-operation in the interested groups failed, it would be his duty to call a conference of state officials to formulate a set of mandatory regulations to avoid a multiplicity of conflicting codes, which, in the absence or delay of standards, would by necessity be enacted in the different states. An insurance representative present merely emphasized the point that the installation of safeguards did not interfere with educational work, but that in reality the work could not well proceed without them.

Dr. Agnew, in giving the policy of the American Engineering Standards Committee, stated that any recommendation of the code committee must be voluntarily adopted by the industry concerned and should not be enacted into law, but rather should be kept in a flexible form as a guide and aid to state commissions and insurance companies in their safety work.

The Building Trades Employers' Association, whose committee on accident prevention I represent, is a local body composed of nearly 1,000 building contractors who confine their operations, with a few exceptions, to this state, which has an industrial code, now under revision to bring it up to date. Our interest in a safety building code, national in its scope, is purely one of co-operation and aid to building construction progress and is not in any sense due to any business advantage to our membership. We do not now go on record nor have we ever gone on record as being either for or against a national code, and these comments should not be construed in any other way than as an attempt to clarify a hitherto muddled situation.

The building industry is the backbone of the nation's progress, but it is suffering an unnecessary economic loss due to an unfavorable accident record. The test of any big business is in honest competition, integrity, usefulness of purpose, elimination of waste and freedom from unnecessary encroachments, rather than the actual size of the business. Preventable accidents mean waste, and waste is inefficiency which the building industry through its contractors is seeking to eliminate as being entirely unworthy of the industry. The more progressive contractors, realizing the advantages of safety, have practiced it, each through individual effort, with a certain measure of success, but it is now realized that concerted and organized effort is required to get the best results. Many other of the larger industries, influenced by legal, humanitarian and financial reasons, have adopted organized safety methods with astonishing results, proving without a doubt that the same principles applied to the building industry must be effective. The good work of the Associated General Contractors of America along this line is unquestionable, but its membership comprises a small percentage of the building contractors in the country. Organized association safety activities are bound to be fruitful, but are they far-reaching enough to get maximum results when confined to their own membership?

In the metropolitan district of New York it has been estimated that more than 50 per cent of the building operations are carried on by owner-builders who are not members of any association which conducts safety activities. These owner-builders in many instances incorporate for the specific purpose of erecting possibly one building and become the general contractors for that operation. Many of them know little of safety or of the industrial code provisions.

There is also that class of general contractors already in business as such who either do not know how to build safeguards or are too penurious to provide good material and put good workmanship in their equipment and, further, who would not provide safeguards because of the cost. This class is in constant competition with the honest and careful general contractor who erects and maintains safeguards at a big expense either in accordance with the local laws or through safety experience.

It has been estimated that the lack of physical safeguards and the improper maintenance of them accounts for 25 per cent of the major accidents on buildings. Most of these accidents are preventable and can be eliminated provided all contractors comply with the legal requirements.

This committee on accident prevention came to the conclusion that if it was to do a real job the educational campaign in accident prevention being conducted among its membership should extend to all of the elements engaged in the work regardless of affiliation, and it is continuing its work along that line. The general plan adopted is to awaken the general public, the owner, the architect, the engineer, the contractor and the mechanic to the serious conditions that prevail and to obtain their support in the movement.

The construction of a modern building, due to the many different trades on the job, is a complicated undertaking, and in order to be safely and economically carried out requires a carefully organized machine. As a matter of economy, in view of the many different contractors on the work, proper safety provisions cannot be fully expected unless the architect upon whom the primary responsibility for the operation rests carefully specifies the safeguards to be made and by whom they shall be made. Our purpose, however, is to build up a human machine rather than a purely economic system and thus increase the efficiency and productivity of the industry, but with the final and even stronger urgency on the grounds of humanity.

Upon contractors rests the secondary responsibility for the faithful execution of the work, but without the promulgation of sound basic safety rules for the guidance of all of them, maximum results in accident prevention will not be obtained. This committee felt that the accident movement should start with the architect, who really is the fountainhead, and with this in mind prepared a safety specification composed of fifteen articles entitled "Protection and Safety Work." It was sent to contractors and to architects in this district with the recommendation that the entire specification be embodied in the general speecifications of all building construction, and co-operation was requested in its application and use.

The adoption of this plan would definitely fix the responsibility for safeguarding on the contractors, each for his own employees, by virtue of his contract. It would not be inequitable, for the reason that it would definitely place the responsibility for safeguarding upon each contractor only in so far as the protection was applicable to his work, avoiding confusion as to who should safeguard a particular piece of work and tending to eliminate duplication in bids for the cost of such safeguarding. Contractors including this cost in their bids would not rely (as is sometimes the practice) upon the safeguarding equipment of others, thereby cutting down a prolific source of accidents caused through the removal of a board, etc., which renders a safeguard inoperative.

Due to its far-reaching effects hundreds of contractors and architects are in accord with our plan and have voluntarily signified not only their willingness to co-operate but their intention to use this specification in all of their work.

While the work of preparing such a national safety code may command serious consideration, it ought not to be a difficult matter, provided the committee adheres to a unanimous plan of developing simplified safety standards, based upon the actual experiences of practical builders who will have to use them, rather than become involved in a maze of technicalities. On Aug. 18 the New York *Herald Tribune*, in commenting editorially on the accident prevention work of the Building Trades Employers' Association, said: "Individual contractors in New York City have had similar success by strict observance of precautions which should be *standard*."

New York, N. Y.,
Aug. 22, 1928.

W. G. WHEELER.
Executive Secretary,
Committee on Accident Prevention,
Building Trades Employers' Association

Sir—After looking over your editorial and considering the discussion at the conference of July 29 I am firmly of the opinion that there should be a construction code and that such a code can be arranged and made workable and reasonable, as there are certain standard practices in construction as well as in other industries that can be used as a basis for such a code. New York State, for instance, has a set of rules with each paragraph devoted to some standard construction practice and prescribes certain safety measures to be used in connection with such practice.

State codes, although they have the force and effect of law, are accepted by the responsible business man and the engineer as a guide rather than a compulsory measure. Indeed, a great many of the industrial leaders take pride in claiming to be a step or two ahead of the codes. There are others who need a guide on modern safe practices, and some to whom the "thou shall" and "thou shalt not" attitude applies. Surely the construction employee is entitled to at least the protection that those in other industries enjoy when one considers that he works under more hazardous conditions.

It is quite true that the task of drawing up a reasonable and workable set of rules will be a difficult one, but with the promised aid of the contractors' associations, this task should not only be reduced but the final product will be made more practical.

The *Engineering News-Record* should be a great agent for stimulating constructive activity among other contractors.

New York, N. Y.,
Sept. 11, 1928.

F. A. GROEPLER,
Special Investigator,
Industrial Board.

News of the Week

Hurricane Causes Great Damage in Sweep Across West Indies and Florida

Structural Damage Undetermined as Insular Cities Report Effects of Worst Storm in Years—San Juan Hardest Hit—Palm Beaches Suffer—Western Tornado Strikes Rockford

A TROPICAL hurricane, first reported on Sept. 11 off the Leeward Islands, swept over Porto Rico on Sept. 13 at an estimated velocity of 150 m.p.h. and reached southern Florida on the 16th, causing loss of life and much property damage wherever it struck. While this storm was in progress two entirely independent local storms of tornado intensity swept through parts of South Dakota and Nebraska and through a part of Illinois. Porto Rico and its leading city of San Juan suffered most heavily from the West Indian storm. The neighboring islands of Haiti, St. Croix, St. Thomas, St. Kitts, Martinique and the Bahamas report desolation and ruin following the storm with considerable loss of life. In Porto Rico no estimate has been made of the damage done to buildings, both public and private, but severe crop damage is general over the island with the coffee crop being reported largely lost.

Communication facilities were wrecked at the first with all radio stations out of commission. Private and naval radio towers alike were blown down. The Candado Hotel and St. Luke's Hospital at San Juan are both reported to have been badly damaged. Other heavy structural damage reported is the wrecking of a recently constructed breakwater on the island of St. Thomas and the loss of several highway bridges in San Domingo.

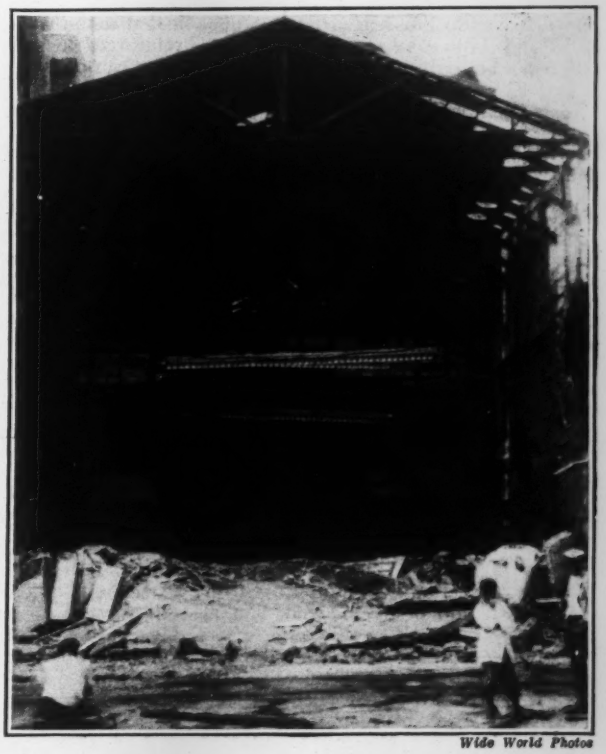
Palm Beaches Badly Damaged

Palm Beach and West Palm Beach bore the brunt of the storm as it swept onto the mainland of Florida. The interior of the state was also hard hit. Little damage to the larger structures and buildings has been reported, most of the damage being confined to the smaller buildings and houses, many of which were unroofed. The loss of life in Florida is reported to have reached 149, with unconfirmed rumors adding to this figure.

Hurricane Fails to Follow Usual Curving Path

Characteristic of hurricanes born late in the season, the disturbance which appeared off the Leeward Islands Sept. 11 failed to recurve in the usual manner and as a result struck the North American mainland, when ordinarily a storm coming from that quarter would have turned northward before reaching the coast of the United States and would have spent itself at sea. Reports to the U. S. Weather Bureau show that the storm did start to recurve in the vicinity of Turks Island, but a high-pressure area moving eastward in the Gulf states tended to straighten out its path and carry the hurricane across the Florida peninsula.

As charted by the Weather Bureau,

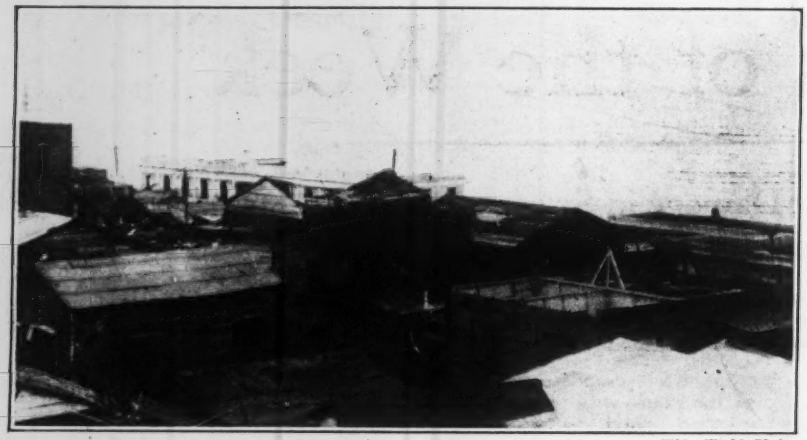


Wide World Photos

HURRICANE DAMAGE AT SAN JUAN, PORTO RICO

Fallen radio tower of the Radio Corporation of Porto Rico

High unbraced rear wall of the Tres Banderas Theater, blown in by the storm



Wide World Photos

Outside the city wall at San Juan—Typical damage to the light wooden shacks

the storm, after having been reported on the fifteenth parallel 400 miles east of the Island of Martinique at 11 a.m. on Sept. 11, was reported at frequent intervals on its course northeastward. At San Juan, Porto Rico, the anemometer was blown away when it was registering 132 miles. The estimated velocity at that point reached 150 m.p.h. A velocity of 120 m.p.h. was registered when the storm passed over Turks Island. A reading of 110 miles was registered at a station on San Salvador at 6 p.m. on Sept. 15. Reports to the Weather Bureau also show that the storm struck West Palm Beach at 5:20 p.m. on Sept. 16, with the barometer reading 28.18 and with a wind velocity of 100 miles per hour.

Illinois and Nebraska Hit

Rockford, Ill., was badly damaged by a tornado last Friday which killed fifteen and wrecked several factories in the southern part of the city, along with numerous small buildings and houses. Most of the loss of life occurred in the four-story brick building of the Rockford Cabinet Company, which was completely wrecked. Rescue work was badly handicapped by a tall smokestack which toppled into the ruins.

The damage from the South Dakota and Nebraska storm was confined to small town and farm buildings and several schools, but the loss of life was considerable, the total being put at eleven.

Minnesota Dam Bids to Be Invited Soon

Specifications have been approved for the construction of a lock and dam at Hastings, Minn. The Corps of Engineers expects to be able to invite bids on the project early in October. This work is a part of the project authorizing the maintenance of a minimum 6-ft. depth in the upper Mississippi, adopted by Congress Jan. 21, 1927. The estimated cost of the project exceeds a million dollars. The lock will be 110 ft. wide and 500 ft. long.

Report Recommends Repairs to Buffalo Coagulating Basins

Repairs to the coagulating basins of the water-filtration system of Buffalo, N. Y., are recommended in a report to Commissioner of Public Works George F. Fisk by H. P. Eddy, of Boston, Mass., and Morris Knowles, of Pittsburgh, Pa., consulting engineers. The principal recommendations contained in the report are that the walls dividing the coagulating basins and the north and south walls of the basins be reinforced. The report states that it is not safe to dewater one basin while the other is full and that the walls should necessarily be reinforced to make this possible, so the plant can operate efficiently.

Inspection of the basins revealed a leakage of 0.3 m.g.d., which has seriously undermined the floor and caused considerable settlement in various places. The report further recommends the repair of the floor safely to withstand the wall thrusts and stresses which occur when the basins are unequally loaded.

The cost of the repairs is estimated at $243,000, distributed as follows: $80,000 for reinforcing the walls, $93,000 for an underdrain system and replacement of floor slabs, $25,000 for a bypass connection, $10,000 for a new sludge pump, $10,000 for miscellaneous minor repairs and $25,000 for contingencies and engineering.

National Research Council to Build Laboratory in Ottawa

Plans are being prepared for the National Research Laboratory Building to be built at Ottawa by the Canadian government under the supervision of the National Research Council. The building will be used solely for laboratory work corresponding to the Bureau of Standards at Washington, and will be 500x50 ft. in plan, three stories high and of stone construction. Dr. Tory, president of the National Research Council, has just returned from a two months' inspection trip of the laboratories and industrial plants of Europe.

Bonnet Carré Spillway Survey Completed

The Mississippi River Commission has completed surveys of two proposed sites for the Bonnet Carré spillway, which will relieve pressure on the levees of New Orleans. Steps are now being taken to obtain options on the necessary real estate. The two sites will be compared in price, and the one costing the less will be selected, according to Major W. H. Holcombe, engineer in charge. Plans are being studied for carrying three railroads and three highways across the spillway, and it is hoped that, as its length is only 5 miles, only one bridge will be necessary. Preliminary requirements for the clearance of the bridge or bridges are now under study by the commission and the railways concerned.

Brief News

City Officials of Beaumont, Tex., will appeal to the federal court or take other action necessary to prevent the J. K. Hughes Development Company or the E. L. Smith Oil Company from drilling for oil in the Neches River bed in Anderson County, on the ground that Beaumont's city water-supply will be endangered.

Cleveland Will Not Vote at the coming November election on the proposed $6,000,000 bond issue to straighten the Cuyahoga River. The city council voted down a resolution by Mayor John D. Marshall to put the question of river straightening, which has been urged for 50 years, on the ballot.

Toll Collections of $278,261.31 are reported on the Harahan Viaduct across the Mississippi at Little Rock, Ark., in the period beginning July 25, 1927, when the structure was taken over by the Highway Department, and ending July 31, 1928. It is stated that the state's share of construction costs on the new viaduct now under construction has been paid from tolls on the old structure.

Final Surveys are being made for the proposed line of the Yankton, Norfolk & Southern Railway Company, between Yankton, S. D., and Norfolk, Neb. Permission for building the new line, 70 miles long, has not yet been granted by the Interstate Commerce Commission.

Notice Has Been Served upon the postmaster at Philadelphia to warn municipal authorities in that city that unless proper airport facilities are afforded airplanes carrying mail, Philadelphia will be removed as a landing port on the route between New York City and New Orleans, the Post Office Department has announced. Mail pilots have had trouble recently in landing and taking off from the Philadelphia field on account of wet grounds.

Syracuse to Build New Intercepting Sewer

The chief engineer of the Intercepting Sewer Board of Syracuse, N. Y., has been authorized to prepare plans and estimates for the construction of a 10-mile intercepting sewer to serve the outlying districts in the northeast section of the city. This will be known as the Ley Creek intercepting sewer. The estimated cost is more than $1,000,000.

Suit Filed in East Bay Water System Dispute

A suit was filed on Sept. 13 in the U. S. District Court at Oakland, Calif., by the East Bay Water Company asking for an injunction against the East Bay Municipal Utility District to restrain the latter from proceeding with the construction of water mains in territory served by the plaintiff. The suit is set for hearing Sept. 24.

The East Bay Municipal Utility District, comprising nine cities on the east side of San Francisco Bay, was organized in May, 1923, to develop a municipal water-supply; in 1924 a $39,000,000 bond issue was voted to finance the construction of a reservoir on the upper reaches of the Mokelumne River and an aqueduct to bring water from that source to the city. The project as a whole was described in *Engineering News-Record*, Dec. 11, 1924, p. 360. Last year voters approved a $26,000,000 bond issue for the purchase or construction of a distribution system. Negotiations for the purchase of the privately owned distribution system have not been successful and the basis for this suit was the district's construction of works necessary for interconnection between the district's mains and the private company's distribution system.

Southern Pacific to Acquire New Line in California

The Southern Pacific Railroad on Sept. 5 applied to the Interstate Commerce Commission for permission to acquire the one-half interest in the Northwestern Pacific Railroad which is now held by the Atchison, Topeka & Santa Fe Railway. If this purchase is effected, it will give the Southern Pacific sole ownership of the Northwestern Pacific, which is now owned jointly by the Southern Pacific and the Santa Fe.

The Northwestern Pacific extends about 300 miles northerly from San Francisco to Eureka, which is a Pacific Coast seaport. Under the sole ownership of the Southern Pacific, so that no competitive feature would be involved, it is believed that the line can be profitably extended to connect with other lines of the Southern Pacific system to the northeast. An agreement among officials of the three railroads involved, it is reported, has already been approved, the price to be paid for the Santa Fe's interest being announced as $4,443,000.

Traffic Over Arthur Kill Bridges Encouraging

Over 271,000 Cars Cross in First Two Months of Operation— Tolls $165,000

Paying $165,000 in tolls, 271,000 vehicles passed over the two new Arthur Kill bridges between Staten Island and New Jersey from the opening on June 29 to Aug. 31. According to John E. Ramsey, chief executive officer of the Port of New York Authority, which built the structures, 124,200 of these crossed the Goethals bridge, connecting Howland Hook, Staten Island, and Elizabeth, N. J., and the remaining 146,800 used the Outerbridge Crossing between Tottenville and Perth Amboy. Access to the bridges during this period has been difficult because of incomplete street approaches at both ends of the Outerbridge Crossing and the Staten Island end of the Goethals bridge.

Despite the unfinished condition of the approaches, the traffic volume has been encouraging, stated Mr. Ramsey. Travel over the Elizabeth crossing has come up to expectations, while that over the Outerbridge has fallen somewhat short of estimates for normal operation. The tolls collected compare favorably with the theoretical estimates of requirements. The operation and interest charges are approximately $830,000 for the first twelve months; $200,000 for operations and the remainder for interest on the $14,000,000 Port Authority bonds.

New Traffic Developed

Travel between Staten Island and New Jersey has been stimulated, as was the expectation of the Port Authority from the first. Traffic on the bridges and ferries combined for the period has been about 165 per cent of that for a similar period in 1927, with the bridges carrying approximately 125 per cent of last year's volume.

Results so far justify the toll charge of 50c. per passenger and 5c. for each additional passenger, with an average of 61c. received from each car. A higher scale of rates obtain for trucks and buses. When the bonds were sold, calculations of probable revenues were based on a toll rate of 60c. per car with 5c. for each additional passenger. The fact that the bridges were opened to travel nine months ahead of the contemplated date has saved the Port Authority $470,000 in interest and has made it possible to charge the lower toll rate.

There is considerable agitation by the communities in some of the bridge areas for a lower rate than is now charged, so the Port Authority is investigating the possibility of establishing a commutation rate of twelve crossings weekly for $4.20.

No final analysis of the traffic volume and tolls received can be made until the bridges have been in normal operation for a period of several months, Mr. Ramsey stated.

War Department Approves Three Bridges

Plans for the following three bridges have been approved by the acting Secretary of War, Col. C. B. Robbins: (1) Bridge to be constructed across the Missouri River near South Liberty, Mo. by the Independent-Liberty Bridge Company, assignee of the Centennial Bridge Company. (2) Bridge to be built across the Allegheny River at Eldred, Pa., by the county commissioners of McKean County. (3) Bridge to be constructed across the St. Croix River, near Grantsburg, Wis., by the St. Croix Interstate Bridge Company.

Train Operation on St. Louis Bridge Favored

A report submitted to the Interstate Commerce Commission by Examiner O. D. Weed recommends operation by the Manufacturers Railway of freight service across the municipal bridge between St. Louis, Mo., and East St. Louis, Ill., and on tracks in St. Louis owned by the city. The application of the Manufacturers Railway was opposed by the Terminal Railroad Association of St. Louis, while the city of St. Louis, the Business Men's Association of South St. Louis and the St. Louis Shippers Conference intervened in support of the proposal. The railroad deck of the municipal bridge, which was completed in 1918, has never been used, although the city authorities have made many efforts to find a tenant for the structure.

Farmer-Owned Railroad Under Construction in South Dakota

Construction has started on the Mound City & Eastern Railroad, a new line 70 miles long extending eastward from Mound City to Leola through a rich agricultural district along the northern border of South Dakota. The ownership and control of the railroad will be in the hands of several hundred farmers of the district which it serves. At present Mound City has no railway connections, and the new line will give a market outlet to the Twin Cities by connecting with the Minneapolis & St. Louis at Leola.

The Jahnig & Davis Construction Company, of Britton, S. D., has been awarded the contract and both members of the firm have been added to the railroad directorate. W. W. Robey, who has had much experience in railroad building with the late Julius Rosholt, is president of the Mound City & Eastern. Theodore J. P. Giedt is vice-president, and Ruth Rosholt, daughter of Julius Rosholt, is executive secretary of the rail company.

Of the estimated cost of $1,600,000, nearly $200,000 has been subscribed by local farmers and the remainder will be obtained by floating bond issues.

Construction work is being pushed from both terminals.

Am.Soc.C.E. Fall Meeting at San Diego Oct. 3-5

The American Society of Civil Engineers will hold its fall meeting at San Diego, Calif., Oct. 3 to 5, inclusive, with headquarters at El Cortez Hotel. The first day's program will be devoted entirely to discussion of air transportation problems.

The various technical divisions open their sessions on Oct. 4 with a list of nineteen papers on the program besides several scheduled discussions. The Highway Division will hear papers on the bitumious treatment of fine crushed rock and gravel roads, and highway problems in relation to cities. The airport problem occupies the entire program of the City Planning Division, with papers on airport ownership and the requirements of size, location and arrangement of municipal airports. The Irrigation Division committee will report on a national reclamation policy at the Irrigation Division session. The reclamation policy of the United States and of the colonial government in India will be discussed by Elwood Mead, U. S. Commissioner of Reclamation, and E. S. Lindley, former executive engineer, Public Works Department of India, respectively.

High dams will be the general subject of a series of five papers presented at a joint session of the Irrigation and Construction divisions. Seven papers giving experiences with activated-sludge plants in California will be heard at the Sanitary Engineering Division.

The last day will be devoted entirely to inspection trips, in the morning to the North Island air station of the U. S. Navy, where the Navy Department has arranged to take those so desiring on airplane flights. In the afternoon an inspection will be made of the U.S.S. "Lexington" or "Saratoga," airplane carriers of the navy, and other naval craft stationed in San Diego Bay.

Concrete Gun Patent Upheld in U. S. Circuit Court of Appeals

For the second time users of the Hackley concrete gun won a legal victory over the Concrete Mixing & Conveying Company when the U. S. Circuit Count of Appeals for the Ninth Circuit on Aug. 20 handed down a decision sustaining a lower court that had "found the appellant's (Concrete Mixing & Conveying Company) patent anticipated and invalid and that even conceding its validity it had not been infringed by the appellee." *(Engineering News-Record* Nov. 24, 1927, p. 854.)

The suit in the lower court was filed by Concrete Mixing & Conveying Company against R. C. Storrie & Company (23 Fed. 2d, 131) after the Storrie company had used the Hackley gun in the lining of the Skagit tunnel in Washington. The plaintiff's claim that the Hackley gun infringed its patent was denied by that court, as noted in the foregoing. The plaintiff's appeal from that decision was recently heard in San Francisco before Judges Gilbert, Rudkin and Dietrich of the U. S. Circuit Court of Appeals. Their findings sustained that of the lower court in all respects. With reference to favorable decisions which the appellant had received in suits involving concrete apparatus of other types (Concrete Mixing & Conveying Company vs. Ulen Contracting Corporation, 12 Fed. 2d, 929, and Concrete Mixing & Conveying Company vs. the Powers-Kennedy Company), the Court of Appeals found decisions in those cases were "based on records widely different from that in the case at bar."

Road Paving Record for New York

Highway contractors working on New York state roads completed 39.96 miles of pavement consisting of 498,410 sq.yd. during the week ended Sept. 11. This exceeds the best previous week in the history of the highway department by 1.07 miles and 46,159 sq.yd. The total mileage of roads paved to date in 1928 is 468.79 with 5,581,884 sq.yd., which compares with 442.55 miles and 5,177,572 sq.yd. for a similar period in 1927.

Missouri Valley Water-Works Men to Hold Meeting

An extended program has been prepared for the annual meeting of the Missouri Valley section of the American Water Works Association at Kansas City, Mo., on Oct. 2 to 5. In addition to a series of papers on the water-supply systems of Kansas City, Mo., and Kansas City, Kan., the papers listed include the following: "Water-Works Improvements on a Cost-Plus Basis," H. V. Pedersen, Marshalltown, Iowa; "Groundwater and Surface Water Supplies," Prof. Earle L. Waterman, University of Iowa; "Motor Drive for Pumping," R. L. Baldwin, Kansas City, Mo.; "Construction of a Distribution System," C. L. Ehrhart, Council Bluffs, Iowa; "Water-Works Valuation for Rate Making," E. B. Black, Kansas City, Mo.; "Relation of Municipal Water-Works to Public Fire Protection," Clarence Goldsmith, Chicago; "Economic Value of Public Health Protection," Earle G. Brown, Kansas State Board of Health; "Use of Electrolytic Cells in Chlorination for the Destruction of Algæ," William T. Bailey, Council Bluffs, Iowa; "Bacterial Synergism and Test for the Colon Group," Dr. Max Levine, Iowa State College; "Determination of Cyanides in Water and Sewage," Jack J. Hinman, Jr., and Samuel D. Poarch, University of Iowa. About fifteen subjects are listed for two sessions of round-table discussions, and there will be excursions to the local pumping stations and filtration works. The secretary is Jack J. Hinman, Jr., University of Iowa, Iowa City, Iowa.

Engineering Societies

CALENDAR

Annual Meetings

NATIONAL SAFETY COUNCIL, Chicago; annual meeting, New York, N. Y., Oct. 1-5.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; fall meeting, San Diego, Calif., Oct. 3-5.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago, Ill.; annual convention, Toronto, Canada, Oct. 8-9.

AMERICAN WELDING SOCIETY, New York, N. Y.; fall meeting, Philadelphia, Pa., Oct. 8-12.

SOUTHWEST WATER WORKS ASSOCIATION, Fort Worth, Tex.; annual convention, Dallas, Tex., Oct. 15-18.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York, N. Y.; annual convention, Chicago, Ill., Oct. 15-19.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis, Mo.; annual convention, Detroit, Mich., Oct. 22-28.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION, Chicago, Ill.; annual convention, Boston, Mass., Oct. 23-25.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, New York, N. Y.; annual convention, Biloxi-Gulfport, Miss., Nov. 13-17.

THE ANNUAL MEETING of the Northwestern Section, Am. Soc. C. E., was held in St. Paul, Sept. 13. Lincoln Bush, George T. Seabury and T. C. Hatton, president, secretary and director, respectively, of the Am. Soc. C. E., were guests of the evening. J. A. Childs, secretary and engineer of the Metropolitan Drainage Commission, St. Paul, was elected president of the Northwestern Section for the ensuing year; H. D. Lovering was elected vice-president and Maurice W. Hewett secretary-treasurer. Bernard Blum, retiring president, was elected representative from the Northwestern Section to the Minnesota Federation of Architectural and Engineering Societies.

THE CONCRETE REINFORCING STEEL INSTITUTE has announced a tentative program for the semi-annual meeting to be held at Shawnee, Pa., Oct. 1-3. Among the subjects of engineering interest to be discussed are "Unusual Construction Jobs," an illustrated symposium; "A History of Building Codes," by Frank Burton, former city building commissioner, Detroit, Mich.; and "Concrete Ribbed Floor Construction," a general discussion. M. A. Beeman, secretary of the association, may be addressed at the Tribune Tower, Chicago, Ill.

THE INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS will consider 22 subjects at the annual conference to be held in Toronto, Ont., Oct. 8-9. Among the papers to be presented of engineering interest are the following: "Disposal of Garbage by the Fermentation Process," by A. Boniface, village engineer, Scarsdale, N. Y.; "Maintenance of Sewage Collection Systems," by W. T. Knowlton, sanitary engineer, Los Angeles, Calif.; "Municipal Air-

ports," by Edwin A. Miller, supervisor of maintenance, Department of Public Works, Rochester, N. Y.; and "What Is Being Done to Streets on Which Are Located Abandoned Street-Car Tracks?" by L. P. Booz, city engineer, Perth Amboy, N. J.

ENGINEERS OF ST. CLAIR AND MADISON COUNTIES, Illinois, have formed a tentative branch of the Illinois Society of Engineers with Charles M. Slaymaker, of East St. Louis, division engineer for the Illinois Department of Highways, as temporary president. B. C. McCurdy, assistant county engineer for St. Clair County, Belleville, Ill., has been named temporary secretary. A permanent organization will be formed later.

THE SOUTHERN APPALACHIAN POWER CONFERENCE is scheduled for Atlanta, Ga., Oct. 8-10. The problems of water-power development and control will be discussed, together with many other phases of power generation and distribution. Wilbur A. Nelson, Charlottesville, Va., is secretary of the conference.

Personal Notes

W. H. HOLMES has resigned as irrigation engineer of the Modesto irrigation district after five years of service.

Major JAMES W. BAGLEY has taken over the duties in charge of the U. S. Lake Survey at Detroit, relieving Lieut. Col. E. J. Dent of this assignment. Major Dent was until recently in command of the 29th Engineers at Fort Humphries, Virginia. Colonel Dent will go to Washington as a student at the Industrial College. Major David McCoach, formerly stationed at the Army War College in Washington, will take over the part of Colonel Dent's duties respecting the office of district engineer of the Detroit district.

Commander GLENN S. BURREL, Civil Engineer Corps of the Navy, has been detached from duty as public-works officer for the fourth naval district at Philadelphia and will go to Washington. He will be placed on the staff of the admiral in chief of the bureau of yards and docks.

A. SIMPSON, formerly British trade commissioner at Sydney, Australia, has been appointed resident chief representative in Australia for Agricultural & General Engineers, Ltd., of London, England.

ROBERT C. STRACHAN, member of the American Society of Civil Engineers and of the Brooklyn Engineers Club, has opened an office in New York City for consultation on bridges, buildings and other structures.

W. K. WARD, of Canadea, N. Y., has been appointed superintendent of construction on the Still Creek dam, near Tamaqua, Pa., for Gannett, Seelye & Fleming, Engineers, Inc., constructor for the Panther Valley Water Company, of Lansford, Pa.

HARRY G. MOORE has been made resident engineer on the extension of Chesnee mill, Chesnee, S. C., for Lockwood, Greene & Company, Inc. Prior to this work Mr. Moore was engaged on house construction, sewerage and sewage disposal for the same corporation at Newbury, S. C., and at Thrift, N. C. His previous positions were as townsite and locating engineer for Chimney Rock Mountains, Inc., resident engineer with the West Virginia State Road Commission and instrument man with the North Carolina State Highway Commission.

JOHN R. HARRISON, formerly with the Koppers Construction Company, Pittsburgh, Pa., in the structural design department, is now chief draftsman with the Austin Brothers Bridge Company, Atlanta, Ga. Previously to his employment by the Koppers company, Mr. Harrison was for twelve years in the structural office of the Dominion Bridge Company, Ltd., Montreal, Canada.

RUSSELL D. WELSH, a graduate of Cornell University and recently employed by W. C. Olsen, Inc., municipal engineers, Raleigh, N. C., has accepted a position as designer with the Morgan Engineering Company, Memphis, Tenn.

N. LOUIS SHAGALOFF, who spent last fall and winter as architect's assistant superintendent on the erection of the Toledo Great Lakes Terminal Warehouse Building for William H. Adams, consulting terminal engineer, Detroit, Mich., is now estimator with the F & Y Construction Company, Columbus, Ohio.

GEZA SZMAK, L. F. SIMONDS, H. WUESTEFELD and RICHARD SCOTT have formed the Construction Survey, New Haven, Conn., as a division of the Universal Engineering Company, of Bridgeport, Conn. The company will specialize in construction surveys, estimates, reports and appraisals.

FRANK R. THEROUX has been appointed sanitary engineer for the engineering firm of Randolph-Perkins Company, of Chicago, and has been placed in charge of a new department of technical supervision of sewage-treatment plant operation. Mr. Theroux, who is a graduate of Cornell University, was formerly sanitary engineer for the city of Miami, Fla., and has also held the same position for other cities. At one time he was with the New York State Department of Health.

ANDREY A. POTTER and ARTHUR N. JOHNSON, heads of the engineering schools of Purdue University and the University of Maryland, respectively, have been appointed members of the Land-Grant College Survey staff of the bureau of education, U. S. Department of the Interior. They will act to prevent a conflict between a survey of engineering in the land-grant colleges and an extensive investigation of engineering education recently conducted by the Society for the Promotion of Engineering Education.

RICHARD S. TWITCHELL has been elected executive secretary of the Affiliated Technical Societies of Boston, succeeding Prof. John B. Babcock, of the Massachusetts Institute of Technology, who recently resigned. For a number of years Mr. Twitchell has been specializing in power apparatus sales and engineering in both steam and electrical fields.

Obituary

CHARLES ESPIN, city manager of Wheeling, W. Va., died suddenly of heart disease on Sept. 8. He was 54 years old.

ADOLPH AST, assistant controller of the American Water Works & Electric Company, Inc., died on Sept. 10 at his home in Montclair, N. J. He had been with the company since 1917 and had served as assistant controller since early in 1926. He was 42 years old.

CHARLES J. PECK, president of the Detroit Engineering Society, died on Sept. 9 after an operation for appendicitis. Mr. Peck, who was 46 years old, was graduated in the civil engineering class of Purdue University in 1906 and had since been connected with the Crane Company, working up to the position of sales manager for the Detroit district.

THOMAS E. MCSHAFFREY, president of the T. E. McShaffrey Construction Company, of Akron, Ohio, died suddenly on Sept. 12 as the result of an acute heart attack. He was 52 years old. Mr. McShaffrey was prominent in the contracting business, his company having constructed miles of roads in and about Akron, the Kenmore bridge, the Hawkins Av. sewer tunnel, a 16-mile pipe line from the Kent dam to the city reservoir and the South Akron trunk-line sewer. At the present time the company is working on the Botzum sewage-disposal plant, the largest building project in the Akron district.

JOHN M. HUTTON, city engineer of Oneida, N. Y., died in a Syracuse Hospital on Sept. 4 following an operation. He had been city engineer of Oneida for fifteen years and acting commissioner of public works since Jan. 1, 1928. Born in Bannock, Ohio, in 1875, Mr. Hutton began his engineering work with the Baltimore & Ohio Railroad in 1899, later going with the Niagara, Lockport & Ontario Power Company at Niagara Falls, N. Y. He also supervised the work of constructing several power plants in New York State, including the dam at Schuylerville and a number of plants for the Schenectady Power Company.

Construction Equipment and Materials

Water Meter Manufacturers Form Association

The American Water Meter Institute is the name of the new association of water meter manufacturers including among its members the following: Badger Meter Manufacturing Company; Buffalo Meter Company; Federal Meter Corporation; Gamon Meter Company; Hersey Manufacturing Company; National Meter Company; Neptune Meter Company; Pittsburgh Equitable Meter Company; Union Water Meter Company, and Worthington Pump & Machinery Corporation. The officers of the institute are W. F. Rockwell, president, and R. S. Bassett, secretary and treasurer.

The institute has been organized for the purpose of co-operation with customers and all others who are interested in promoting the welfare of the water-works industry. Any manufacturer of water meters whose business is conducted principally in the United States is eligible to membership. The avowed purposes of the institute are as follows:

1. To eliminate practices and methods detrimental to the entire water-works industry.

2. To work for the further acceptance of the present "Standard Specifications" so that the members of the institute may be protected against unnecessary changes in materials or changes in design and construction unless and until such changes are warranted by the progress or the needs of the industry, and to eliminate unreasonable specifications and guarantees.

3. To promote open discussion of trade conditions and to bring about a clearer understanding of the problems of the manufacturer, vender and consumer.

4. To act jointly on such problems as freight rates, exhibits and attendance at conventions.

5. To promote the use of water meters wherever possible and to make a concerted effort to show the public in general and publicly owned water-works officials in particular that the use of water meters is desirable.

Excavator Company Increases Manufacturing Facilities

Major expansion plans of the Byers Machine Company, Ravenna, Ohio, began with the moving of the Massillon Power Shovel Company's plant to Ravenna at the end of August. Equipment and inventory of the latter plant were purchased late in 1927. Release of some foundry space, due to the decrease in the use of gray iron castings in power shovel manufacture, and rearrangement of existing units of the Ravenna plant will permit the expansion with few new buildings. The Byers Machine Company has secured the fifteen-acre site and buildings recently vacated by the National Carbon Company. This will be used for overflow from the present plant, for warehouses and for a testing ground for the company's power shovels, cranes, ditching machines and graders. Rearrangement of the plant will be effected in time to swing production up in preparation of an adequate inventory for the heavy spring demand. The increased under-cover storage facilities will make possible the storage of a large output in first-class condition, according to the company.

Concrete Road Yardage

Below is given a tabulation of concrete pavement yardage awarded during August, 1928, together with the total number of square yards awarded in roads, streets and alleys for the year to Sept. 1, 1928. These figures represent awards in the United States of America only:

	Sq.Yd. Awarded August	Sq.Yd. Awarded Jan. 1 to Sept. 1
Roads	9,253,622	69,666,219
Streets	7,083,403	37,445,677
Alleys	551,586	2,635,708
Totals	16,888,611	109,747,604

Business Notes

LINDE AIR PRODUCTS COMPANY, New York City, announces that four new plants have already started production of oxygen. These plants are located at Harrisburg, Pa., in charge of J. J. Naber; at Allentown, Pa., in charge of W. Barber; at Shreveport, La., in charge of F. T. Rueger; and at South Charleston, W. Va., in charge of Ed Pohlman. The opening of these plants brings the total up to 52 producing plants located throughout the country.

KAESTNER & HECHT COMPANY, manufacturer of building elevators, will now be known as the Westinghouse Electric Elevator Company, with headquarters and plant in Chicago. F. A. Hecht started a machine building business in Chicago more than 50 years ago, and some time later branched into the elevator business. The Westinghouse company has held a controlling interest in the business since 1926. The company will operate as a separate unit of the Westinghouse Electric & Manufacturing Company. The officers of the new company are E. M. Herr, chairman of the boards of directors; F. A. Merrick, president; R. I. Phillips, vice-president and general manager; E. D. Kilburn, vice-president; W. S. Rugg, vice-president; N. G. Symonds, secretary; F. E. Craig, general auditor; H. F. Baetz, treasurer, and Frank C. Reed, general sales manager.

NATIONAL PAVING BRICK MANUFACTURERS ASSOCIATION has announced the removal of its headquarters from 332 South Michigan Ave., Chicago, Ill., to the National Press Building, Fourteenth and F Sts., Washington, D. C.

WEST COAST LUMBER TRADE EXTENSION BUREAU announces the removal of its general offices from Longview, Wash., to 364 White-Henry-Stuart Building, Seattle, Wash. The bureau has been consolidated with the West Coast Lumbermen's Association and will become the trade extension department and information department of the association.

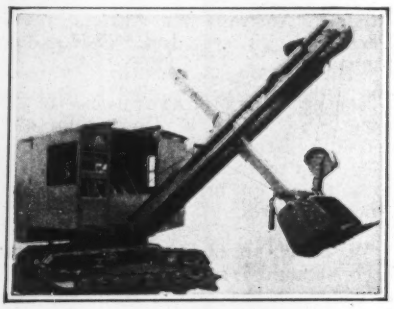
HIGHWAY BRIDGES, INC., 57 William St., New York City, has been organized for the purpose of financing, constructing and operating highway toll bridges in various sections of the United States. P. K. Schuyler is chief engineer of the company.

J. BAYARD KIRKPATRICK, vice-president, Neptune Meter Company, New York City, died on the S.S. "Rotterdam" two days out from New York on Sept. 10. Mr. and Mrs. Kirkpatrick had started a trip to Switzerland, where Mr. Kirkpatrick had expected to spend a period of convalescence following a serious operation. He was born in 1872 and was graduated from Harvard University and attended the Harvard Law School until 1897. In 1900 he was elected secretary and director of the Neptune Meter Company. Mr. Kirkpatrick was vice-president of the American Water Meter Institute and a past-president of the Water Works Manufacturers Association.

New Developments

New Full Revolving Excavator With Five Attachments

A full-revolving excavator to be known as Type R has been announced by the Insley Manufacturing Company, Indianapolis, Ind. The machine includes many features of advanced de-



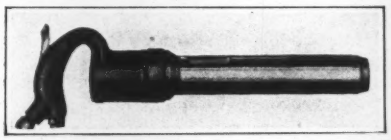
sign, including roller bearings for all shafts above the revolving frame, cut gears throughout, cast-steel car body, cast-steel machinery base and side frames, separate control for each crawler, and one-shot lubrication for the crawler rollers. A special feature is the use of hydraulic brakes which operate separately on each crawler and which are controlled from the operator's platform. The brakes operate as effectively in one direction as in the other, eliminating the necessity of dogs or chocks. The excavator is made with five attachments, the shovel, ditcher, skimmer, crane and dragline. The machine has a tail swing of only 7 ft.

The Type R shovel uses the company's patented cable crowd. The shovel boom is 17½ ft. long, giving a dumping clearance of 12½ ft., or is equipped with a high lift boom and dipper for any clearance up to 15 or 16 ft. A gear-driven power boom hoist is used. The ditcher uses the same boom as the shovel and has an effective digging depth of 18 ft. The skimmer has a digging radius of 20½ ft. from the center of rotation, a dumping clearance of 10 ft. and carries a bucket with ½-yd. working capacity.

The crane with a 35-ft. boom is furnished as standard equipment. The crane's capacity is 5,200 lb. at 18-ft. radius, 4,500 lb. at 20-ft. radius and 2,500 lb. at 30-ft. It is said to have more than ample capacity to handle a ½-yd. clamshell. The power boom hoist is of great value on crane work, since the boom can be raised and lowered under a load. The dragline bucket used has a half-yard working capacity.

Rivet Hammers Developed in Four New Sizes

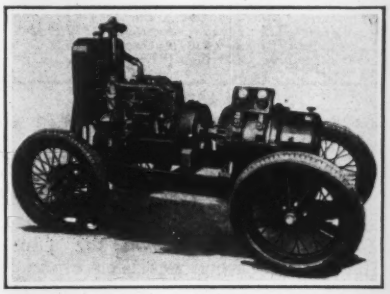
A new line of riveting hammers in four sizes, having strokes of 5, 6, 8 and 9 in., has been developed by the Ingersoll-Rand Company, New York City. An important feature of the new ham-



mers is the manner in which the handle is fastened to the barrel and kept tightly in place by a spring locking device. The handle is threaded to the barrel and the spring lock not only prevents the handle from unscrewing but applies tension to automatically tighten it. The valve operates in a hardened and ground valve box located at the head of the barrel and clamped in place by the handle. The valve box has a solid upper end which provides a positive compression chamber for the piston on its up stroke. It always acts to prevent the piston from striking the handle end, as this air cushion is not dependent upon an air-tight joint between the handle and the barrel. An open-type outside trigger handle is standard, but closed or inverted type handles can also be supplied.

Welding Set Mounted on Wire-Wheeled Truck

A new gasoline engine-driven welding set has recently been developed by the Fusion Welding Corporation, 103d St. and Torrence Ave., Chicago. It is powered by a 23-hp. Continental four-cylinder engine and has a welding range from



50 to 300 amp. The outfit weighs 1,596 lb. and the pneumatic tired wire auto wheels on the truck contribute to its easy portability at fast speeds. It is said that its gasoline consumption is about 1 gal. per hour. A metal hood, not shown in the illustration, completely incloses both motor and generator.

New Pipe Covering of Asphalt and Cement

An asphaltic protective covering known as Hydralt was developed several years ago by J. B. W. Gardiner, Inc., 50 Church St., New York, which consisted of minute particles of asphalt mechanically suspended in water, the water acting both to separate the particles and to provide a vehicle by means of which they could be spread. When applied to an exposed surface, the water evaporated and the asphalt particles ran together, forming an asphalt envelope over the surface. The material was applied by hand brushing, by spraying or by dipping. Hydralt was described in *Engineering News-Record*, Oct. 8, 1925, p. 613.

The company has recently introduced what it calls Armored Hydralt, which consists of a heavy coat of asphalt surrounded by a protective shell of cement. Application is not radically different from that used with straight Hydralt. Immediately after the Hydralt has been applied and while it is still wet, the surface is covered with a dry portland cement, which acts as a blotter, taking the water out rapidly and so setting the asphalt while using the water for its own hydration. It is claimed that the cement, being heavier than Hydralt, sinks into it slightly at the surface and that both the asphalt and cement, setting together, interlock. A number of advantages are claimed as a result of this cement shell: Wrapping or incasing an asphalt coating adds greatly to the protective value of the asphalt during the effective life of the incasing material; the surface density of the asphalt film is increased; the asphalt coating is protected from stones and pebbles that may be in the earthfill; and transportation difficulties are eliminated by preventing the pipes from sticking together in transit; means is provided by which the pipe can contract and expand in the ground without the coating being displaced or disturbed by the surrounding soil.

Manufacturers and Trade Associations

CALENDAR

ANNUAL MEETINGS

TRACK SUPPLY ASSOCIATION, Chicago; annual exhibition and convention, Detroit, Sept. 18-20, 1928.

CONCRETE REINFORCING STEEL INSTITUTE, Chicago; semi-annual meeting, Buckwood Inn, Shawnee-on-Delaware, Pa., October 1-3, 1928.

New Publications

Surveying Instruments—KERN COMPANY, New York City, has issued a catalog PJ-1, describing all surveying instruments produced by the company, including levels, theodolites, transits, alidades, plane table equipment and tachometers. The booklet gives photographs, specifications and prices. This company has also reprinted a paper read before the Washington Society of Engineers by W. R. Kern, entitled "What the Engineer Should Know About Surveying Instruments."

Diesel Engines—THE OTTO ENGINE WORKS, Philadelphia, Pa., has issued Bulletin B, a 16-page booklet, written in non-technical language, which gives general information about the Superior-Otto Diesel engine. No attempt is made to go into detailed specifications, as the object of the book is simply to show typical installations and give an account of the history of the Diesel engine and of the company.

Cement Mill Machinery—KENNEDY-VAN SAUN MANUFACTURING & ENGINEERING CORPORATION, New York City, describes in a 40-page catalog the Kennedy line of ball mills, compressors, driers, kilns, coal pulverizers, tube mills and other machinery used in the cement industry. The publication is known as bulletin No. 14. Besides photographs, specifications and descriptions of the equipment, there are two articles on the production of cement in a modern plant which are of general interest.

Rock Asphalt—THE KENTUCKY ROCK ASPHALT COMPANY, Louisville, Ky., has issued "The Kyrock Book," a 32-page publication describing the history and method of application of Kyrock, the natural rock asphalt pavement produced by the company. There are many illustrations showing typical applications of the paving in various parts of the country.

The Business Side of Construction

Downward Trend in Industrial Disputes

Disruption of industrial activity through trade disputes has been on the decline throughout the world since 1920, according to an analysis made by the National Industrial Conference Board on the basis of official reports from eight representative countries. A notable exception is Australia, where the number of workers involved in industrial disputes has changed little during the period under review and in 1927 was the highest ever recorded.

The most turbulent years during the period 1919-27 were 1919 and 1920. A total of 13,133,877 workers were thrown out of work by strikes or lockouts in the former year and 13,698,620 in the latter in the United States, Great Britain, France, Germany, Belgium, the Netherlands, Canada and Australia. These eight countries thus account for nearly 86 per cent of an estimated world total of 16,000,000 persons involved in trade disputes in 1920. In the United States the total number directly involved in industrial disputes in 1919 was 4,160,348, or 40 workers per thousand population; in 1920, 1,463,054, or 14 per thousand of population; in Great Britain the number thus deprived of work in 1919 was 63 per thousand of population, and 45 in 1920; in France, 31 and 37 respectively; in Germany, 75 and 135; in Belgium, 22 and 40; in the Netherlands, 9 and 10; in Canada, 16 and 6, in Australia 19 per thousand of population in each of the two years.

The extent of the economic loss to the workers in these two years can be partly gaged by the working time lost through these industrial disputes: In Great Britain in 1919, 34,970,000 working days were lost, and 26,570,000 days in 1920; in France, 18,110,352 in the former year, and 24,247,132 in the latter; in Germany, 48,067,180 and 54,206,942 respectively; in the Netherlands, 1,094,700 and 2,333,900; in Australia, 6,308,226 and 1,872,065; records of time lost for the other countries named are not available.

E. N.-R. Index Numbers

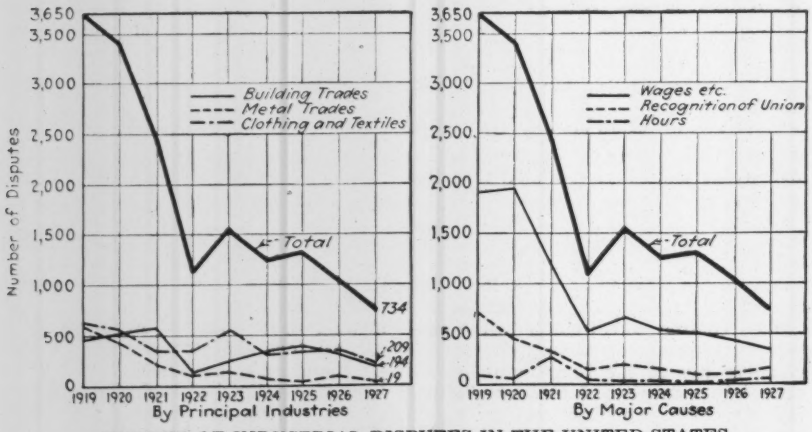
Cost		Volume	
Sept. 1, 1928	**207.29**	**August, 1928**	**306**
Aug. 1, 1928	207.29	July, 1928	266
Sept. 1, 1927	203.60	August 1927	306
Average, 1927	206.24	Average, 1927	263
Average, 1926	208.03	Average, 1926	228
1913	100.00	1913	100

Disputes in Building Trades Decrease

During the past eight years there has been a noticeable decrease in the number of industrial disputes in the United States. This trend has been especially apparent in the building trades. In 1919 almost 500 strikes took place among the building trades of the nation for various reasons. In 1921 this figure was raised to around 510, and this was the peak year of industrial unrest in the building trades. The year following was one of great building expansion and only about 125 strikes were recorded among the building trades. Last year there were 194 such disputes.

By far the outstanding cause of industrial disputes in general involves the question of wages, although as wages have slowly risen the relative proportion of disputes from this cause has rapidly decreased. Second in cause is the recognition of the union, which has decreased from about 730 disputes in 1919 to only 171 in 1927. The question of hours of work plays a very minor part in the industrial disputes of the nation.

One of the basic economic problems of the future is the total elimination of industrial disputes, which is only a special phase of the great problem of eliminating waste in industry. The Department of Commerce has accomplished much during the past few years toward the elimination of material waste in industry. The Department of Labor is attacking the labor problem in the same sense—the elimination of physical and financial waste on the part of the American wage earner.



NUMBER OF INDUSTRIAL DISPUTES IN THE UNITED STATES

Money Rates and Construction

Data on the value of contracts let for private construction projects during the past ten weeks indicate that the hardening of money rates during the past few months is now being felt in the general construction industry. The value of contracts let for private construction projects during the months of June, July and August averaged well above $40,000,000 weekly. During the first two weeks of September, however, the average value of contracts let for private construction dropped to $29,350,000, the week of Sept. 11 totaling only $25,533,000, although government construction continued at a high figure.

The prevailing opinion among economists is that the changed credit condition means that the construction industry is facing a period of firm money. New capital will cost more, which will have a retarding effect upon the initiation of new projects. This condition comes after a prolonged period of very active construction operations, which has already produced certain weaknesses in the situation. But on the other hand these economists point out that general business and industrial operations are of a high order and will probably remain so during the remainder of the year, that rapidly advancing construction costs are absent and that nowhere in the country are there boom conditions to be exploded with consequent depressing effects. The conclusion to be drawn from these economic forces is that a smaller volume of construction is in prospect but that the decrease will be gradual and will not be such as to prove of a major detrimental influence on general business.

Cement Production Exceeds That of Last Year

The ratio of the operations to the capacity of the American portland cement industry during the month of August was 93.1 per cent, according to figures just released by the Bureau of Mines of the Department of Commerce. During the month 18,730,000 bbl. were produced, 21,970,000 bbl. were shipped, and there were in stocks on hand at the end of the month 19,340,000 bbl. Production in August, 1928, was 2.3 per cent more and shipments were 2.6 per cent more than in August, 1927. Stocks at the mills were 18.7 per cent higher than a year ago.

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week ended Sept. 18, with some comparisons, total as follows:

(In Thousands of Dollars, 000 Omitted)

Week Ended	Public	Private	Total
Sept. 18, 1928	**$47,099**	**$45,437**	**$92,536**
Sept. 11, 1928	35,587	25,533	61,120
Sept. 20, 1927	28,015	24,659	52,674
Jan. 1 to Sept. 18:			
1928	1,023,437	1,594,538	2,617,975
1927	931,078	1,363,426	9,294,505